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A Short History of the Lick Observatory*

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I. The Founding of the Observatory

During a visit to the Lick Observatory last summer the Editor of Popular Astronomy suggested that I should write a short history of the Observatory for publication in that magazine, and the idea was seconded by Director Shane. I accepted the invitation with the aim of giving in the article the framework about which a larger and more detailed history can be built in the future.

The history of the Lick Observatory is interesting as a bit of Californiana, aside from its astronomical aspects. Its history is very closely connected with the histories of the State of California, the City of San Francisco, the young University of California, and Santa Clara County. It also touches upon the life and activities of men in business, finance, education, and professional work for the first forty years of the State's existence.

Since 1930, when Dr. Aitken asked me to be the librarian for the Lick Observatory, I had collected for the files all material, important and otherwise, which relates to the historical side of the Observatory. This collection consists of numerous articles concerning the founding of the Observatory, the construction of the buildings, and the purchase of equipment. They were written not only by members of the Trust and of the early staff, but also by professional writers for the daily press and magazines. Then there is on hand the correspondence of the early days, notes of instructions to builders and workmen, the records of bills paid by the Trust (a world of information in itself), hundreds of photographs of the early days on the mountain, and volumes of news clippings. This material is available to anyone who might care to use it, to form a bird's eye view of the Observatory's history without the distortion that time produces.

Of the several historical sketches written about the Lick Observatory, only three can be considered authoritative. The first, chronologically, and the one of greatest weight, appeared as a special edition of the *Daily San Jose Mercury*, dated June 28, 1888, the day after the "Formal Recognition of the Transfer of the Lick Observatory to the Regents of the University of California." In this lengthy article of some 35,000 words, the story of the founding of the Observatory is told. Although the article is not signed, there is little doubt that the greaer part of it came

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from the pen of Professor Holden, the first director of the Observatory.

A second history of the Lick Observatory was written by Miss Millicent Shinn, a graduate of the University of California in 1880. She published an article concerning the Lick Observatory and its staff in the November, 1892, number of the now defunct *Overland Monthly*. The verbatim statement by Professor George Davidson published by Miss Shinn, shows clearly the influence of this man in planning and placing the Observatory, as well as his relations with James Lick in the formation of the famous Trust, or rather, Trusts. Miss Shinn was well acquainted with the construction period, and also with the early staff and the organization of the Lick Observatory. She was an active writer for magazines, a professional book reviewer for several eastern publishing houses, and was considered by many to be a competent authority on California's history.

The third authoritative note on the history of the Lick Observatory was written by Director W. H. Wright, on the occasion of the fiftieth anniversary of the Lick Astronomical Department of the University of California. In this article, published in the *Publications of the Astronomical Society of the Pacific*, Vol. 50, No. 295, June, 1938, Dr. Wright summarizes and analyzes salient facts based on Miss Shinn's notes and on other news reports. He calls attention to the very important historical fact, that the Lick Observatory owes its existence not only to the great money gift of Mr. James Lick, but also to the enthusiastic efforts and labor of men like D. O. Mills, Captain Floyd, Professor Newcomb, and others who worked towards the creation of the then largest and best equipped astronomical observatory—all as a labor of love.

Surprisingly little is known of the men who, in the seventies and eighties of the last century, took such great interest in the establishment of the Observatory. We know a good deal about the life and habits of Mr. James Lick, who gave the money to build the Observatory, but we do not know how or when the idea of erecting an observatory came to him. Although Mr. Lick changed his will twice before forming the Lick Trust, and also changed the Trust twice during the last three years of his life, the telescope was always the principal item of his several bequests. It was at that time that the daily press was very much occupied with the erection of the new U. S. Naval Observatory in Washington, D. C., and its great refractor of 26 inches aperture.

In this short history we must necessarily introduce men whose names appear here and there as the story develops. First on the scene is, of course, James Lick, San Francisco's millionaire, who for a mere $700,000.00 purchased for himself an enduring memorial, the Lick Observatory. Another well-known millionaire at that time spent twice as much money on a second-rate actress, and both their names are forgotten.

A short biographical sketch of Mr. Lick has recently been published

by the Princeton University Press. The author is Dr. William H. Worrilow, president of the Lebanon Steel Foundry, Lebanon, Pennsylvania. Dr. Worrilow is greatly interested in the history of Lebanon County and its early settlers, and the Lick family were settlers before the days

FIGURE 1
Photograph of bronze tablet above the door leading to the 36-inch dome.

of the Revolution. He delivered a lecture before the Newcomen Society in San Francisco on February 16, 1949, entitled "James Lick (1796-1876), Pioneer and Adventurer, His Role in California History." For the purpose of a history of the Lick Observatory, this biographical sketch is about as complete as is needed.

Mr. Lick was born August 25, 1796, in the village of Stumpstown, now Fredericksburg, Pennsylvania, of Pennsylvania Dutch parents. His grandfather, William Lueck (the 'u' Umlaut) served in the war of the Revolution. William's son, John, changed the family name to the anglicized Lick, and he was the father of our James Lick. John Lick was a small farmer and an expert cabinet maker of considerable local fame, who taught his trade to his son James. James' love for fine wood and good cabinet work remained with him for life. His schooling, typical of that of his day and place, was gained in a small parochial Lutheran school. James' mother died when he was sixteen. At the age of twenty-one he left home to seek his fortune in Baltimore and New York, where he worked as an expert piano maker. About 1821 he de-

cided to emigrate to Buenos Aires, where he established himself in business. Within a very short time he became prosperous by importing from the United States piano works, for which he as a cabinet maker furnished the cases. Ten years later he returned to the States quite unexpectedly, bringing with him a cargo of hides and nutria furs valued at $40,000, according to his own statement. After a few weeks at home he realized that he had been away too long to be content in his native land, and hence he again left for South America, taking with him a cargo of staples and flour, which he sold advantageously in revolution-ridden Buenos Aires. Shortly thereafter he went to Vaparaiso, Chile, where he established another piano business and remained for four years. For the following ten or eleven years he was engaged in business in Lima, Peru, from which city, after selling all his interests, he came to San Francisco in 1848. Lick, a man of many paradoxes, was 52 years old when he arrived in California. Shortly before gold was discovered in California, he arrived on a sailing vessel, the *Lady Adams*, bringing with him about $30,000. Mr. Lick invested his money in real estate, first in and about San Francisco, and somewhat later in Santa Clara County and other parts of California. All his investments increased in value so that within twenty-five years these properties were valued at a hundred times their original purchase price. The financial success of this man was due to foresight and natural business acumen, but no doubt the factor of good luck was also involved.

Many persons considered Mr. Lick a recluse and an eccentric; some even thought him to be miserly and very selfish. As was often the case with real estate deals at that time, Mr. Lick's purchases came in for title disputes before the courts in San Franciso. Always a compromiser, he soon managed to settle his law suits with only a $10,000 overall payment to his opponents. This left him free to devote his time to some of his many whims. He purchased lands in Santa Clara County and devoted the next twenty years of his life to the construction of buildings and to the development of orchards and gardens. Near San Jose he built the famous flour mill known as "Lick's Folly." He constructed several fine residences on his estates, none of which he ever occupied. In San Francisco he built the famous Lick House, at its time the most famous family hotel in the west. Early in 1873, at the age of 77, he moved to a small room in the Lick House, where he died on October 1, 1876.

James Lick had never married, but he had a great number of relatives in Pennsylvania. The principal of these was John Lick, a natural son. James Lick acknowledged him as his son, and had him living for years on the Santa Clara estates where he had to work like any other farm laborer, never receiving the least consideration from his millionaire father. He finally left his father, settled in Pennsylvania and became a very successful business man by his own effort. Like his father, he never married, and when he died on October 13, 1893, he left a fortune

reputedly in the millions according to newspaper reports. He never visited the Lick Observatory.

The last three years of Mr. Lick's life were far from being inactive. In January, 1873, he surprised all California by giving the Mahogany Mill (Lick's Folly) and the land about it, to the Thomas Paine Memorial Association of Boston, with the request that the property be sold. Half of the receipts were to be spent for a memorial hall in Boston, and the other half for the endowment of lectureships. This Association soon sent an attorney to California with power to sell Lick's mill. The attorney sold the property for $18,000 cash, without consulting Mr. Lick or even paying him a visit of courtesy. The mill and its wonderful equipment had cost something like $200,000. There exists a statement by Mr. Lick that he would have gladly given $50,000 cash for the property had the attorney come to see him for advice. Needless to say, Mr. Lick lost all interest in the advancement of the theories of Thomas Paine. The Lick Mill, originally a flour mill, was turned later into a paper mill manufacturing paper bags. It was destroyed by fire on July 7, 1882.

But another surprise awaited the people of California. On February 15, 1873, not one month after his gift to the Thomas Paine Memorial Association, Mr. Lick executed two gift deeds, one to the California Academy of Sciences, the other to the Society of California Pioneers in San Francisco. These gifts were in the form of valuable lots near the corner of Market and Fourth Streets in San Francisco. Certain conditions were attached to these gifts, but both societies urged Mr. Lick to remove these restrictions, which he actually did at a later date. It is at this point that the history of the Lick Observatory begins.

Professor George Davidson was the president of the California Academy of Sciences when Mr. Lick gave the valuable piece of property to the Academy. He called on Mr. Lick in the Lick House to thank him for the gift, and it was there that Mr. Lick told Mr. Davidson about his intention of leaving a large sum of money for a telescope, "larger and more powerful than any existing." Professor Davidson was naturally interested, because of his experience as a practical astronomer with the U. S. Coast Survey for more than twenty years. Davidson was held in high esteem by many Californians, and he was a truly great man of his time, whose work and ability were recognized by all. His advice and judgment were sought frequently by the State, the City of San Francisco, and, later, the University of California. Davidson was a Regent of the University of California from 1877 to 1884 and he held an honorary title of Professor of Astronomy and Geodesy in this institution. Many years later at the age of 73 he was appointed Professor of Astronomy and Geodesy at the University of California, but he retired two years later as Emeritus. His connection with the founding of the Observatory is best told in his own words, as given to Miss Shinn in 1892:

"James Lick originally intended to erect the Observatory at Fourth

and Market Streets. His ideas of what he wanted and what he should do were of the very vaguest character. It required months of careful approaches and the proper presentation of facts to change his views of location. He next had a notion of locating it on the mountains overlooking his millsite near Santa Clara, and thought it would be a Mecca, but only in the sense of a show.

"Gradually I guided his judgment to place it on a great elevation in the Sierra Nevadas, by placing before him the results of my experimental work at great elevations, as well as the experience of other high-altitude observers. At the same time, by my presentation of facts and figures of the cost and maintenance of other observatories, he named the sum of $1,200,000 in one of his wills, as the sum to be set aside for founding the James Lick Observatory, and for its support.

"In making him acquainted with the size and performance of the telescopes of the larger observatories, I naturally mentioned the great reflector of Lord Rosse. That seemed to fire his ambition and at the next interview he insisted on a refractor of six feet in diameter. It required long and patient explanations to get him down to forty inches, which was the diameter we finally adopted.

"In October, 1873, I obtained his permission to make known to the California Academy of Sciences the main facts of his intention to place the largest refracting telescope that could be constructed at an elevation of 10,000 feet in the Sierra Nevadas. I have not the announcement within reach, but it was published in the *Alta California* late in October, I think about the 21st. A short time before that I had confidentially made the facts of Lick's intention known to Leland Stanford and his wife.

"An eminent astronomer had nearly frustrated the whole project by urging Mr. Lick to adopt a reflecting telescope instead of a refractor; but he had a remarkably clear mechanical mind and I had very little trouble in satisfying him of the weakness of the suggestion.

"Before I went to Washington for consultation with other observers for the Transit of Venus expeditions of 1874, Mr. Lick held to the decision of the refractor at a great elevation and details had been decided upon, although he had several times changed his will in other matters. Before departing, I showed him that by the Code of California he could not then devise by will to any corporate body, and urged him to make a Deed of Trust.

"Upon my return I found that he had made the Deed of Trust and that some of the Pioneers had prevailed upon him to locate the observatory on the north shore of Lake Tahoe, and had prevailed upon him to reduce the $1,200,000 to $700,000.

"When he again changed his views and determined to locate the observatory on the vastly inferior site of Mount Hamilton, I declined further conference with him.

"The whole of my intercourse with him was full of curious and

interesting and sometimes dramatic incidents, that have never been sought by anyone professing to write the history of the Lick Observatory."

For over one and a half years Mr. Lick was occupied in consultations, correspondence, and plans about the various bequests, among which the erection of the large telescope was always foremost. He found many willing advisors, men prominent in business and in professions, whose names figured largely in the history of California. I shall mention only a few of them. There was Mr. J. D. Staples, a very active and influential member of the California Pioneer Society, who seemed to know everybody in San Francisco. He was a frequent visitor to Mr. Lick in the Lick House. Others were Mr. T. H. Selby, the Mayor of San Francisco; Mr. D. O. Mills, the banker; Dr. D. C. Gilman, President of the young State University of California; Mr. Ralston of the Palace Hotel in San Francisco, and others. Mr. Lick listened to all willingly, but he kept his own counsel and followed his own way.

On July 16, 1874, Mr. Lick executed a Deed of Gift of his entire fortune to seven men, the so-called First Lick Trust, for the purpose of carrying out his bequests. Mr. D. O. Mills was the President of the Trust and his name figures largely in the subsequent history of the Lick Observatory. The portion of the trust deed that concerns the Observatory is copied herewith.

"First Trust Deed

Extract in Relation to the Location of the Great Observatory.

That portion of this trust deed which refers to the Lick Telescope is as follows:

> "Second—Out of the proceeds of the sale and disposition of the property herewith conveyed and transferred, and intended to be, to expend the sum of seven hundred thousand dollars ($700,000) for the purpose of constructing and putting upon the land heretofore deeded to the party of the first part hereto, on or about the fifth day of November, Eighteen Hundred and Seventy Three (1873), by Henry M. Yerrington, Duane L. Bliss, and James A. Rigley, the said lands being situated on the borders of Lake Tahoe, County of Placer, State of California, a powerful telescope, superior to and more powerful than any telescope ever yet made, with all the machinery appertaining thereto and appropriately connected therewith, or that is necessary and convenient to the most powerful telescope now in use, or suited to one more powerful than any yet constructed, and also a suitable observatory connected therewith. Provided, however, if the site above designated shall not, after investigation, be deemed suitable by said Trustees, or a majority of them they shall elect a site on which to erect such telescope, but the same must be located within the State of California. The parties of the second part hereto and their successors, shall retain forever

the title to said site for said telescope; and if by any provision of law the said Trustees, parties of the second part, and their successors, cannot hold the title to said site and appurtenances to be put thereon, then they shall convey the same to the State of California."

In the latter part of the summer of 1874, Mr. Mills went to Washington, D. C., to consult Professor Simon Newcomb of the U. S. Naval Observatory. The firm of Alvan Clark & Sons had given Mr. Lick an estimate of the probable cost of the type of telescope that Mr. Lick had in mind. He considered the firm's price too high, expressed his displeasure in no uncertain terms, and decided to have no dealings with the Clarks in the future. So the question now before the trustees was, what other firm, here or in Europe, could possibly attempt to make the desired telescope. From the several conferences between D. O. Mills, Professor Newcomb, and his staff, three measures of historical interest to the Observatory emerged. In the first place, Professor Newcomb, as agent of the Trust, went to Europe to visit the greater optical shops and glass works, and also to inspect the observatories where large telescopes were mounted. As a second measure, upon the advice of Professors Newcomb and Holden, Professor Newcomb was authorized to purchase astronomical books for the contemplated observatory library. Newcomb brought about five hundred volumes back with him. Thus the Lick Observatory library had its start years before the road to the top of the mountain was built. These volumes still contain the gummed label "Lick Observatory Library; Property of Lick Trust." The third measure was the tentative appointment of a director for the observatory-to-be.

Newcomb recommended to Mr. Mills the appointment of young Professor Holden, who was then Newcomb's assistant on the great equatorial in Washington. Mr. Mills was favorably impressed by this twenty-eight year old enthusiast and they must have reached some understanding on his future appointment, although no written record of any agreement exists. Later this lack of written agreement led to some unpleasant publicity for Professor Holden. It should be said, however, that Holden was always thought of as the coming director by each of the three successive Boards of Trustees. All this is very pleasantly told by Newcomb in his book, "Reminiscences of an Astronomer," published in 1903.

Toward the end of 1874, Mr. Lick became more and more impatient about the slow progress the Trust had made in the few months of its existence. Then, as now, few ever realize the great difficulties that are met, and the time required for an undertaking such as the construction of a large observatory. Since all other bequests hinged more or less upon the completion of the observatory, this delay caused much grumbling by the other beneficiaries, and the daily press was far from friendly towards the Trustees. Every member of the Trust was sincere and cap-

able of doing his share in carrying out the Trust's task. Nearly a million dollars worth of real estate had been sold by the Trust during the first few months of its existence, all to the advantage of the Lick estate.

Nevertheless, once more Mr. Lick electrified the citizens of San Francisco by the publication of a "Revocation of the Trust" on March 27, 1875. From a legal standpoint the Trustees could not be dismissed, or the Trust dissolved, for the original Trust was absolute. Mr. Lick turned to the well-known law firm of Felton & Hittell in San Francisco, to break the Trust. Mr. J. B. Felton, the senior partner of the firm, contracted to do so for a contingent fee of $100,000 and Mr. Lick signed the contract. Mr. Felton suceeded within a few months, in a roundabout way, when everybody including Mr. Lick, expected years of court litigation. Without going into court directly, Mr. Felton, with the aid of a very willing press, formed "public opinion" such that every member of the first Trust was willing to resign with the Court's permission, but, before resigning, they voted for each of the five men Mr. Lick had selected for his second Trust. Mr. Felton, who prepared the legal papers for the second Trust, saw to it that his fee was the first item on the agenda of the new Trust's business. Mr. Felton was very influential in having the contemplated Observatory turned over as a gift to the University of California instead of to the State of California. Upon Felton's advice Mr. Lick offered the Observatory to the Regents, and they gratefully accepted. They officially named the future Observatory the "Lick Astronomical Department of the University of California." This was done even though size and type of telescope and location of the Observatory had not yet been determined.

The president of the second Trust was Captain Richard S. Floyd, the man who eventually constructed the Lick Observatory, and who later, as president of the third Trust, turned the completed establishment over to the Regents of the University. Another member of this second Trust was Mr. D. B. Murphy, mayor of San Jose, whose great interest in the Observatory was instrumental in locating the Observatory on top of Mount Hamilton in Santa Clara County. He influenced the County supervisors to build the County road to the top of the mountain, and saw that the necessary steps were taken to obtain the land about the projected site. This was done later through an Act of Congress.

Mr. Murphy, with Mr. Thomas E. Fraser, Lick's trusted manager of his Santa Clara properties, rode on horseback in August, 1875, to the top of Mount Hamilton to investigate it as a possible location for the Observatory. Both men were very much impressed with the clearness of the view from the top, and especially with the easy access to the mountain. When Mr. Fraser gave his report to Mr. Lick a few days after this excursion, Lick's decision was made then and there that Mount Hamilton was the place upon which the Observatory was to be built.

A third member of the Trust who must be considered in connection

with the history of Lick Observatory is Mr. John H. Lick of Lebanon, Pennsylvania. He never signified his acceptance of trusteeship and he could not be pursuaded to carry out any of the Trust's affairs in James Lick's home town, Fredericksburg, Pennsylvania. This inactivity on John Lick's part irritated the old gentleman to the extent that he changed his Trust again on September 4, 1876, dismissing all members except Captain Floyd. Less than four weeks after this action Mr. James Lick died, on October 1, 1876. Upon learning of James Lick's death, John H. Lick came to San Francisco, asked the court for letters of administration of the Lick estate, and asked also that the Trust be dissolved. During the subsequent legal contest the Trust's business became inactive for some time and none of the real estate could be sold on account of the disputed title. The delay later proved to be a blessing. The market value of real estate had declined, and if any property had been sold during that time, the money produced would not have been sufficient to satisfy every one of the various bequests. The market values improved later to such an extent that all properties could be sold at prices that insured the complete settlement of the bequests.

On this scene there came another man, who although not a member of either the second or third Lick Trusts, was intimately connected with both and was active during the construction period of the Lick Observatory. This man was Mr. H. E. Mathews, secretary to both Trusts. Captain Floyd chose him as the best man to fill this important position, and a good choice it proved to be. The secretaryship was a highly responsible position that required initiative and an endless amount of tact. Mr. Mathews remained as secretary to the Trust until its final dismissal by the court in the late nineties. During the building of the Observatory Captain Floyd assumed overall supervision. Mr. Fraser was the superintendent of construction on the mountain, while Mr. Mathews was the secretary in the San Francisco office. The trio thus formed was a team of unusual efficiency and harmony, and better yet, they remained life-long friends.

When Mr. Lick, in the latter part of the summer of 1875 made up his mind that Mount Hamilton was to be the site for the Observatory, he immediately proposed to the supervisors of Santa Clara County that a county road be built to the top of Mount Hamilton. He offered to take bonds for the money that he would advance toward the construction of this road. The proposal was seconded by many important citizens of the city of San Jose and of Santa Clara County. However, it required legislative action to have the County issue bonds for that purpose, and, since the land about and near the top of Mount Hamilton was U. S. Government property, it required Congressional approval to deed the necessary site to the Regents of the University.

Actual road building began in March, 1876, and continued until June of that year, when the contractor disappeared leaving everything in an unsettled state. The road work started again sometime in the following

October under another contractor and was completed by the end of that year, 1876. The total cost was $73,075.81, and one still wonders how in those days before automobiles and power machinery, such a magnificent road could have been built in so short a time and at so low

FIGURE 2

Smith Creek Hotel on the road to Mt. Hamilton, built shortly after the completion of the road in 1876. It served as a Hotel for Lick Observatory visitors and for the changing of horses for the regular stages. Hotel and all other buildings were taken down in 1936 after sixty years of existence. The space is now occupied by the California State Forest Service for fire protection during the summer months.

a cost. The road was laid out by Mr. A. T. Hermann of San Jose. He was a civil engineer trained in Germany, and was the County's Surveyor at that time. Many engineers visiting the mountain still express their admiration for the skill shown in laying out this excellent mountain road. They frequently ask the question, "Who was the engineer who laid out this road?"

As to the naming of this mountain, one must go back a few years into the history of California. By the year 1860 the people of California felt the need of a survey of their mineral and natural resources. The outstanding man interested in such a plan was Mr. Stephen J. Field, Justice of the Supreme Court of California and later of the Supreme Court of the United States. He advocated a complete State-wide survey, free from politics and local influences. He sought the advice of trained men in this field and asked for the recommendation of a suitable director for such an undertaking. The choice fell to J. D. Whitney, a Yale graduate, who had been engaged in various State surveys in the eastern part of the United States. In spite of strong opposition in the State

FIGURE 3

On the road up from Smith Creek showing the early stages for mail, visitors, and supplies.

Legislature, he was finally appointed director of the State Geological Survey and served in this capacity from 1861 to 1874.

Whitney selected Professor W. H. Brewer for his chief assistant and Mr. Charles F. Hoffman for his topographer. These two men were working about San Jose near the end of August, 1861, and they surveyed the "high peak" to the east in company with the Rev. Laurentine Hamilton of the San Jose Presbyterian Church. Our widely-known mountain was named after this clergyman.

The origin of the name of Mt. Hamilton was soon forgotten, and, even during the construction of the Observatory in the eighties, the question of its meaning frequently came up, and, although various answers were given, none were satisfactory. However, an article published in the *San Francisco Examiner* about June 1, 1891, by E. H. Hamilton, the son of Rev. Hamilton apparently settles the question. In this article is quoted a letter by Professor William H. Brewer of the Sheffield Scientific School of the Yale University, dated January 31, 1888, and part of this letter is as follows:

"I made the acquaintance of Rev. Laurentine Hamilton of Ovid, New York, in 1853, where his first pastorate was, and where he remained about two years—1853 to 1855. I was then a teacher in the Ovid Academy, as was also Miss Isabella Mead, whose acquaintance he there made and whom he married in May, 1855, just before his starting for California. Certain personal matters, which need not be given, made our mutual friendship with both him and his wife especially intimate and pleasant. I next met him in August, 1861, when, in charge of the little

field party of the State Geological Survey, I camped in the suburbs of San Jose, where Mr. Hamilton was then preaching, and during our short stay there I was often at his house. Professor Charles F. Hoffmann, topographer of the State Survey was with us, and thus became acquainted with Mr. Hamilton.

"We had already been on all the chief points about San Jose; Pacheco's Pass, New Almaden, etc., and from various points had noted about where the highest point in the mountains east of Santa Clara Valley was located.

"On Sunday I attended Mr. Hamilton's church and in the afternoon took tea with him and mentioned we would attempt to reach the highest peak east on the next day. He wanted to go with us and early the next morning (Monday, August 26, 1861) he was at our camp. He, Mr. Hoffman, and I made the party.

First On Top

"There were no special difficulties met with other than those incident to the absence of tracks, the occasional fields of brush and our ignorance as to the best route. There were no trails, nor had I obtained any information of the country beyond the laguna (probably at Smith's Creek). We finally picketed our mules and made the last three miles on foot. Hoffman and I were encumbered with our instruments and as we neared the summit, Mr. Hamilton pushed on ahead of us and reaching it, swung his hat in the air and shouted back to us: 'First on top, for this is the highest point.'

"The air chanced to be unusually clear for that time of the year and the views were correspondingly fine, especially to the westward.

"Night caught us while we were still in the mountains, but we reached our camp before midnight.

"I thought it probable that this peak, which is somewhat conspicuous from the heights on the opposite side of the valley, must have already some name, but I failed to find any. I made diligent inquiries then and later, both thereabouts and elsewhere. Indeed, any definite information about the interior of that chain was curiously scanty, considering how long the Santa Clara Valley had been settled. It had been well prospected over between 1849 and 1860, but beyond the fact that paying gold was not to be found in the streams, and that bears were plenty, I got little information.

"When we worked up our notes in the office, and failing to find any old name in use, Hoffman and I, after discussing two names, agreed to call it Mount Hamilton. This is how it happened that the now celebrated mountain came to bear the name of that able and true man.

"I have a clear remembrance of the events, and I write this letter after referring to my original notes made at the time. Yours truly, Wm. H. Brewer."

Years after E. H. Hamilton's account had been forgotten, Professor Campbell published the story of the naming of the mountain following

a personal interview with Professor Brewer. This story appeared in the *Publications of the Astronomical Society of Pacific,* Vol. 18, page 225. A third account appeared in Brewer's Journal "Up and Down California in 1860-1864" published by the Yale University Press in 1930.

After the death of Mr. James Lick and after the famous compromise between Mr. John H. Lick and the Trustees had been effected, the Trustees were free to build the Observatory as they deemed best. Their decisions were that the telescope was to be a refractor of thirty-six inches clear aperture, that the rough disks were to be furnished by the firm of Feil & Son of Paris and that the lenses were to be figured by the firm of Alvan Clark & Sons. Behind all these decisions one sees clearly the influence of Professor Newcomb. In the summer of 1879 Captain Floyd and Mr. Frazer spent about one month in Washington, D. C., in conference with Newcomb and Holden. The final plans for the great telescope, the building and other additional astronomical equipment were carefully worked out. In fact, these gentlemen planned an entirely new institution that was a far cry from the original notion of Mr. Lick, namely, "a telescope superior to any." In order to settle the question of the most suitable observatory site once and for all, Professor S. W. Burnham of Chicago was engaged by the Trustees to test the seeing conditions on the top of Mount Hamilton. He arrived about the middle

FIGURE 4

November, 1881: The first buildings on the mountain top—All these buildings have disappeared now. The large building was the superintendent's house and served also as a boarding house for a while.

of August, 1879, began his observations immediately, and for about two months resided on the mountain. Burham's conclusions, as reported to the Trustees, clinched the location. Newcomb spent several days in September of 1879 on the top of the mountain, in the company of Floyd and Frazer, and the three studied the topography and decided upon the location of buildings. Active construction of the Lick Observatory was begun shortly after the New Year in 1880. For the first few months the work consisted chiefly of hauling the necessary materials to the mountain top.

Several springs had been found near the summit and these assured an adequate water supply. By July, 1880, workshops, barns for horses, and temporary living quarters for workmen were up. A road was built to the spring on the north side of Copernicus Peak, the highest of the several peaks of Mount Hamilton. A boiler house and a steam pump were installed near the spring. Water was then pumped into a reservoir on Kepler Peak. This peak was somewhat lower than Copernicus, but a little higher than the proposed site of the main building.

To the west of the Observatory, right on the County road and some eight hundred feet below the top, a bed of reasonably good clay was found and bricks for the buildings were manufactured there. This find meant a saving for the Trustees of about $46,000 in transportation charges. The next step was levelling the mountain top for a site of approximately one acre for the main building. The top had to be blasted off to a depth of about thirty feet and some 40,000 tons of rock removed. All this took the greater part of the year 1880. Early in the spring of 1881, the work of laying the foundations for the Observatory buildings began. The transit house for the four-inch transit and zenith telescope by Fauth & Company was the first astronomical building completed, and the masonry of the building for the twelve-inch equatorial telescope was finished second. Originally the 12-inch telescope was built by Alvan Clark & Sons for the Portuguese Government, which made one advance payment on it, but was never heard from again. After eight years of waiting, the Clarks felt free to dispose of the instrument and sold it to the Lick Trust. The original objective was figured for photographic work. Professor Henry Draper of New York had a visual 12-inch lens by Clark, which he planned to replace by a photographic one, and thus a happy exchange was made. Frazer built the 25.5-foot dome for this instrument on the mountain. The framework is of light wood and is covered by thin nickeled copper sheeting. Rotation of the dome was effected by an endless steel cable running on the outside of the dome and down around the groove of a two-foot wheel, placed in a recess of the wall of the observing room. This scheme for dome turning was rather new at that time, but later became general.

In October, 1881, Professors Holden and Burnham came on the occasion of the mounting of the twelve-inch telescope; they made tests, and observed the transit of Mercury in November of that year with this

FIGURE 5

The first observatory buildings, October, 1881. The twelve-inch telescope dome just completed and the housing for the Fauth Transit Instrument—Professor Burnham in the center. Holden and Burnham came to observe the transit of Mercury, November, 1881.

instrument. The twelve-inch telescope was frequently used by visiting astronomers before the large refractor was completed. With it Professor David F. Todd, of Amherst College, observed the transit of Venus, on December 5, 1882.

During 1882-1883 the Trust was annoyed by attacks of the two residuary beneficiaries of Lick's bequests, who, with the aid of a very willing San Francisco daily paper, became very outspoken in their demands for an early settlement. The public had to be educated to understand the enormous task the Trust had on hand concerning the Observatory. Although the work of building went ahead steadily on Mount Hamilton, criticism of the slowness of progress and the spending of too much money was rife. A great deal of credit for settling this useless newspaper controversy goes to a Trustee, Mr. George Schoenewald, the manager of the famous Del Monte Hotel in Monterey. He was on friendly terms with Mr. James Lick for years before Lick's death. He was also a good friend of Captain Floyd. In his capacity as the manager of the famous hotel, he met many people of importance and influence and he made his contacts count in favor of the Trustees. Years back when Mr. Lick and Mr. Schoenewald talked about the various locations for an observatory site, Mr. Schoenewald had suggested the top of Mount St. Helena in Napa County. Mr. Lick, although ailing, was anxious to see the top of this mountain. Schoenewald arranged for transportation and had Mr. Lick placed on a mattress in a light spring wagon. However, on the way up, the mattress with Mr. Lick on it, slipped out of

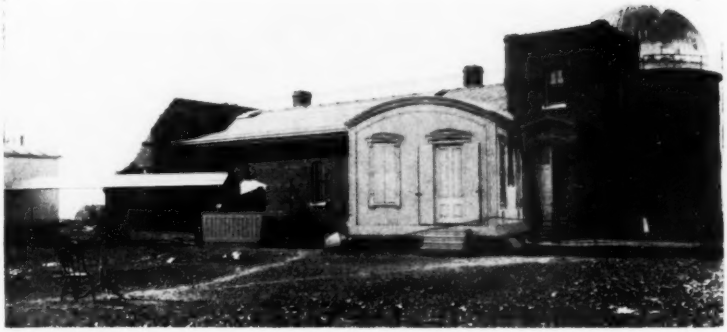


FIGURE 6

Transit house and part of Main Building in December, 1882. The photo-heliograph instrument was used by Professor Todd to observe the transit of Venus, December, 1882.

the vehicle, and thus Mount St. Helena was eliminated from among the possible observatory sites. This mishap, however, did not destroy Mr. Lick's confidence in Mr. Schoenewald.

In 1884 the Meridian Circle House was completed according to a design of Professors Holden and Comstock, and the Meridian Circle was installed. This instrument was ordered by the Trustees in 1882 from Messrs. Repsold in Hamburg and it was inspected and tested by Professors Auwers and Krueger in Germany before being shipped to Mount Hamilton in 1884. It is a first-class instrument of its kind.

A post office was established on Mount Hamilton on December 1, 1884, but the difficulty of getting contractors to haul the mail from San

FIGURE 7

Construction in progress in June, 1883. Mr. Fraser on the top of tank.

Jose to Mount Hamilton caused the post office to be temporarily discontinued on June 18, 1886, toward the end of the busiest construction period. Some years later, on June 1, 1890, the post office was re-established on Mount Hamilton and has been in continuous existence ever since.

Captain Floyd, like Professor Newcomb, looked on Professor Holden as the future director of the Observatory. Floyd's friend, Judge John S. Hagar, was a member of the Regents of the University of California and a powerful political figure in San Francisco. Through Judge Hagar, Captain Floyd suggested that the Regents have Professor Holden come to the University to bridge over the interim until the Observatory should be ready for its director.

In 1885 Professor Holden was elected president of the University of California with the understanding that he was to assume the directorship of the Lick Observatory. It was expected that this would be completed within two, or at most three years. The main building was completed by 1885 except for the big dome. On October 10, 1885, the Trustees received word from Alvan Clark & Sons that the rough disks for the crown glass were now on hand and the figuring would proceed at once. Open bids for the present mounting of the 36-inch telescope were called for and Warner & Swasey of Cleveland were the successful bidders. The price of $42,000 was agreed upon and the construction began immediately.

The 36-inch lens was expected to be completed sometime in the fall of 1886. The next question was, who could construct the 76-foot dome, and for how much. Only one firm in the United States submitted a bid and the price demanded was deemed too high by the Trustees. There were too many strings attached to the bids of the European ironworks, so they could not be accepted. The Trust decided finally to have the big dome built in San Francisco by the Union Iron Works. Mr. Irwin M. Scott, the head of this concern, was certain that his firm could give satisfaction at a reasonable price. Captain Floyd asked Mr. Fraser to work out preliminary plans for the steel dome and after several weeks of intense work, always being on the lookout not to infringe on any of the existing patents, Fraser submitted his sketches to the manager of the Union Iron Works, a Mr. Dickie. Both Fraser and Dickie worked out the sketches so that they could be turned over to the drafting department. As far as these two men could find out, none of the sketches submitted by others had made allowance for heat expansion, which amounts to about 1½ inches in the 235 feet circumference. The Union Iron Works then constructed the dome. The final cost of the dome was $56,850, almost 50% lower than the bid of any other reliable firm.

On January 8, 1887, before the dome was completed and when the pier was just started, Mr. Lick's body was placed at the foot of the big telescope with appropriate ceremonies. The simple, dignified plate, indicating

"Here lies the body of James Lick"

is as impressive now as on the day of his second burial.

The 36-inch objective arrived December 29, 1886, and was placed in a safe built for that purpose, awaiting the completion of the mounting and dome. Almost a year later the last carload of tubing arrived, accompanied by Mr. Ambrose Swasey, who personally supervised the mounting of the telescope. He brought with him the 33-inch photographic lens, of which more is told later.

By June 1, 1888, the Trustees felt that their task was completed as far as the construction of the Lick Observatory was concerned, and they were anxious to settle all other bequests still on their agenda. The Lick Observatory was from now on to be a part of the University of California. The Regents received, in addition to the completed establishment, a sum of $90,000 cash, the amount left of Lick's original gift of $700,000 after defraying the cost of buildings and the purchase of

FIGURE 8

Group of Staff of Lick Trust in 1886: left to right, back row—Captain Floyd, Trustee, President of Trust, Mr. Mathews, Secretary of Trust, Mr. Fraser, Superintendent of construction, Mrs. Floyd, Professor Keeler, Assistant to the Trust, Professor Comstock, Assistant to the Trust, Miss Mathews, sister of Mr. Mathews. Foreground, left to right: Mr. Plum, Trustee, Mr. Mastik, Trustee, Professor Hilgard of the University of California, President Holden of the University of California, Miss Floyd, daughter of Captain Floyd.

instruments. The Regents of the University were informed and the formal transfer took place on June 27, 1888. Professor E. S. Holden took charge as director. The story of his administration, of the staff of astronomers he selected, and of life on Mount Hamilton in the early days of the Lick Observatory will be the second part of this short history of the Lick Observatory.

This first part will close with a short sketch of the three men who were most actively connected with the actual building of the Observatory. They were Captain Floyd, William Fraser, and Mr. Mathews, as colorful three personalities as any found in the annals of California. Captain Floyd came from a well-known and reputedly prosperous southern family, was a cadet at the United States Naval Academy, which he left in 1861 at the age of eighteen years. During the Civil War he went to sea; he came to California in 1865 and settled in San Francisco. For two or three years he commanded steamers on the West Coast, hence the title Captain. His private means were such that he could retire early in life and devote his time to the development of the estate he purchased on the shore of Clear Lake, California. The name of his beautiful home was "Kono Tayee," and it was the meeting place for his many friends. He was a well-known figure in San Francisco's business and social circles. He had a State-wide reputation for great ability and for getting along with men in all stations of life. He

FIGURE 9
Photograph of Captain Floyd taken in Paris, France, 1876, while on Lick Observatory business trip—age 33 years.

was Mr. Lick's choice for president of the second and third Lick Trusts. For his own share of the Trust's business he selected the planning and supervising of the construction of the Lick Observatory, a piece of work he evidently enjoyed. He devoted ten years of his relatively short life to this work, all as a labor of love. The last two years were spent in residence on the mountain, to be near the work he loved so well. He died suddenly on October 17, 1890, at the age of only 47 years. We quote a few words from his obituary written by Professor Holden and published in Vol. 2 of the *Publications of the Astronomical Society of the Pacific*, October 18, 1890. "His character was such that those brought near to him loved him, and no difference of opinion could shake their affection. When the history of the Lick Observatory comes to be written, the name of Floyd must hold a conspicuous and honorable place in its annals." From all that can be gathered from records, it is not an exaggeratioin to state that the Lick Observatory, as it finally came into being, was the brain child of Captain Floyd.

Another name that will always be connected with the history of the Lick Observatory is that of Mr. Thomas E. Fraser, the superintendent of construction from 1879 to 1887. Mr. Fraser entered the employ of Mr. James Lick in 1873, while Lick was still living on his Santa Clara estate. He came from Nova Scotia and was skilled in cabinet making. As he was a mere youngster at that time, his formal schooling could not have been very extensive. But his natural mechanical and inventive gifts, and also his business ability, showed themselves early and he soon became the trusted manager of the Lick properties in Santa Clara County. Fraser remained in Lick's employ until Mr. Lick's death. It was Fraser who introduced Captain Floyd first to Mr. Lick. After Lick's death his services were transferred to the Trust, and, as a general utility man, he continued in such service until 1879, when Captain Floyd had him appointed superintendent of construction of the Observatory. As a self-educated construction engineer he produced praiseworthy results. His talents and inventive gifts are still evident. He was the highest paid employee of the Trust. In 1887 when the Observatory was all but completed he severed his connection with the Trust and became connected with a large California estate in San Francisco and some two or three years later he purchased farm lands and real estate in Banning, Riverside County, where he died suddenly on October 6, 1891, only 41 years old. It was said of him, as in the case of his friend Captain Floyd, that death was due to overwork.

Finally there was Mr. H. E. Mathews, who, as secretary of the second and third Trusts, served faithfully in the task of settling all bequests. He had been a professional photographer for a time before entering the services of the Trust. His hundreds of photographs of the Observatory during construction and of the scenery about the Observatory are still of great interest.

Mr. Mathews lived to be an old man. In February, 1920, when he

was eighty years old, still hale and hearty, he wrote in his own handwriting a little book "indited and presented to the Lick Observatory," which contained the notes of an address delivered by him before the Society of California Pioneers concerning the history of the Lick Observatory and of the Lick Trust. The handwriting is as clear and distinct as it was in his younger years as secretary of the Trust. There is nothing new to be found in these notes, but they reflect in a refreshing manner the admiration held by Mr. Mathews for his friends, Captain Floyd and Mr. Fraser.

But this trio, Floyd, Fraser, and Mathews, accomplished in their way something that can hardly be understood in these modern days. Their correspondence among themselves is of fascinating interest. Captain Floyd's hundreds of instructions to Fraser or Mathews, scribbled on any old piece of paper; Fraser's almost illegible reports with his own peculiar spelling, and Mathews always friendly replies, are gems. The result of their combined efforts was the original Lick Observatory, the finest of its day.

(To be continued)

Chinese Astronomical Jades

By HENRI MICHEL

Chinese jade objects are the oldest astronomical instruments which have reached us. They were used during the tenth century, B.C., and perhaps earlier. These jades have been known by collectors under the designation of "astronomical jades," although nobody explains why they were so called. There is a vague tradition that they might have been used in ritual ceremonies, for the worship of heaven and earth, but even Chinese commentators seem unable to tell their real purpose.

Some ancient texts also mention an enigmatic object, called *siun-ki yü-hêng*, explaining in very sibylline terms that this was an instrument for "observing the constellations" and "knowing the celestial houses." A Chinese mathematician of the 2d century, Tcheng-Hiuan, writes as follows: "The part of the instrument which had a turning motion was the *ki*; the part which was held in the hand for observing was the *hêng*; both were made of jade. With them were measured the degrees of motions."

The words *siun-ki* and *yü-hêng* have a very clear meaning: *ki* is a rotating instrument; *siun* is a special quality jade; *hêng* is a tube, made of ordinary jade: *yü*. The *siun-ki yü-hêng* consists thus of two parts: the instrument itself, and the tube.

Every jade collector knows a tube, made of common jade, designated under the name of *ts'ung*. It is (Fig. 1) a square prism, generally 4 to 10 inches long and 3 to 4 inches wide. Its ends are rounded and form two projecting cylindrical rims, tangent to the flat faces of the prism.

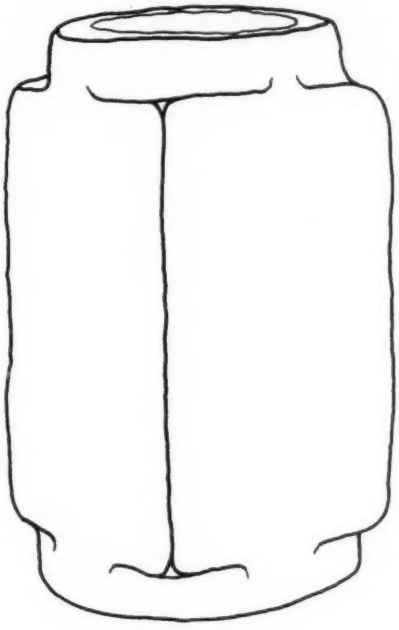


FIGURE 1
Primitive *ts'ung* (or *hêng*).

The latter has a cylindrical hole along its axis. A few years ago, the *ts'ung* was sometimes considered as a wheel-nave. I shall show that it was a nave indeed, but the world's axle's nave.

As to the *siun-ki*, it is a flat disk with a large central hole (Fig. 2) generally 5 to 6 inches wide and very thin (⅛ to ⅙ inch). It is made of a special translucent, pale green jade, which with the time, may become blurred and brownish in places. This *ki*, curiously cut, shows three deep notches at 120° from each other, and very often, three series of serrations between these teeth. Besides, two straight lines are engraved on its face: one double line, tangent to the hole, and one single, almost diametral and at right angle to the first.

Here again, collectors know another jade disk, the *pi*, which is a simple, round plate with a central hole. According to an old Chinese ritual book, the *pi* was the symbol of heaven, while the tube *ts'ung* was the symbol of the earth. Nobody tells how or why.

I think that *pi* and *ts'ung* are evolved forms of the *ki* and the *hêng*, and that initially the first was used for the observation of stars, while the second was adjusted to the terrestrial horizon. In this way, these jades were related to heaven and earth. Of course, the learned did not

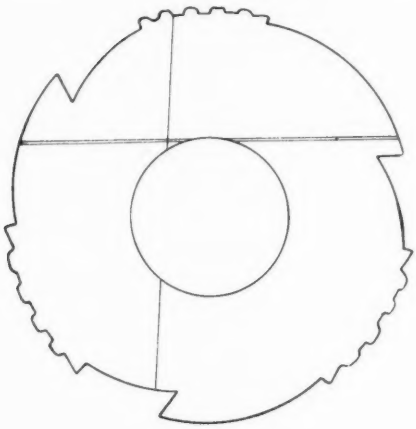


FIGURE 2
Siun-ki, 600 B.C. Brussels; Musées d'Art & d'Histoire; Coll. Huet.

divulge this to profanes, and veiled it under mysterious ceremonies. With the time, during the terrible wars of the last centuries, B.C., and after the systematic destruction of books in —213, the scientific meaning of the instrument was lost, and only a vague esoteric tradition remained. The two jades became progressively ritual or honorific, like the stars on medals nowadays.

If we wish to understand the purpose of this astronomical instrument, we must first ask ourselves what problem the Chinese astron-

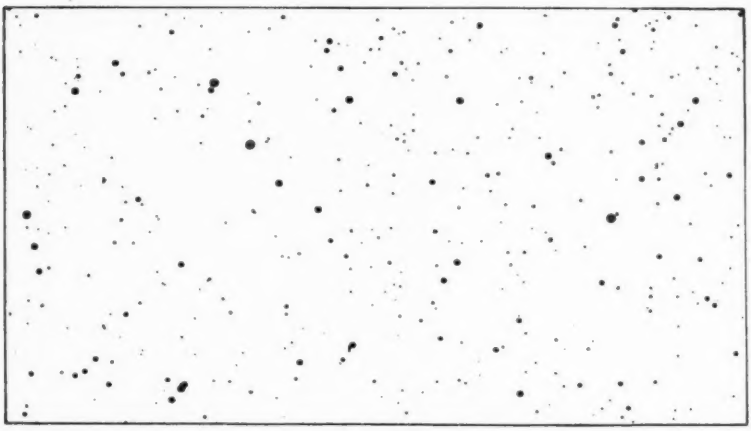


FIGURE 3
The celestial pole from 3000 B.C. to A.D. 2000.

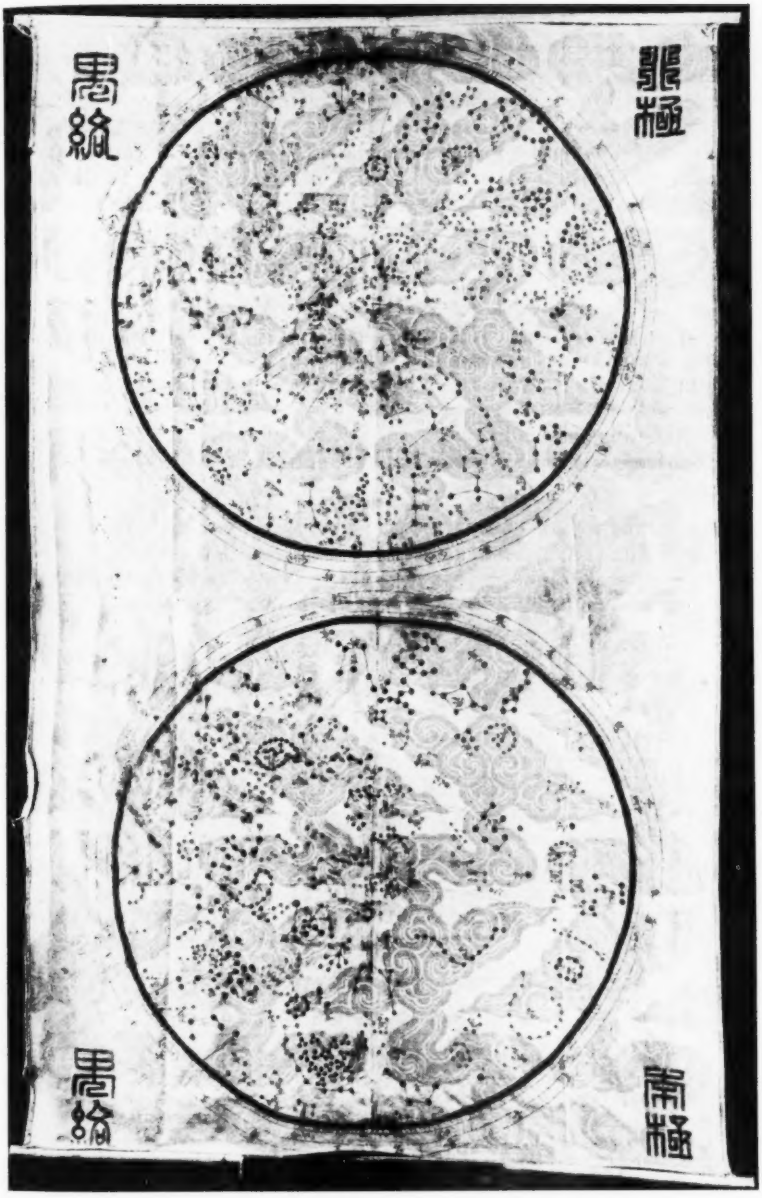


FIGURE 4
Chinese celestial map, painted on imperial silk; probably XVIIIth cent.
Brussels; Coll. H. Michel.

omers wanted to solve. The main subject of their preoccupations was the definition of the annual calendar. Being farmers and hence dependent on the seasons, the Chinese used a solar year, beginning at the winter solstice. The most important ceremony of the year was the distribution, by the Emperor himself, of the new calendar. The date of the solstice was known by observing the length of the shadow of a standard gnomon. The observation took place at the summer solstice, the shortest shadow being easier to observe than the longest. The winter solstice was supposed to come 183 days later. In the meantime, the daily position of the sun in the zodiac was not obtained by direct observation, as the sun cannot be seen simultaneously with the stars, but by observing the full moon, which is in opposition to the sun. The 28 mansions of the heaven, the *sieou*, showed the 28 successive positions of the moon in the course of a month. They were defined by certain stars. It was also necessary to know the direction of the colure of solstices, and of course the celestial pole. The location of the pole is a problem which, today, does not worry us very much, as our pole star, α Urs. Min., is quite

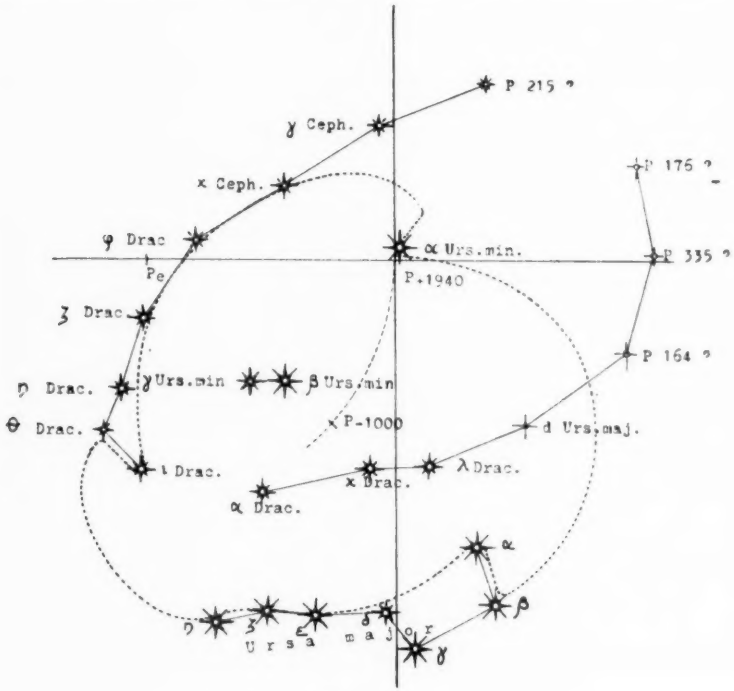


FIGURE 5
The circumpolar stars, 1000 years B.C.

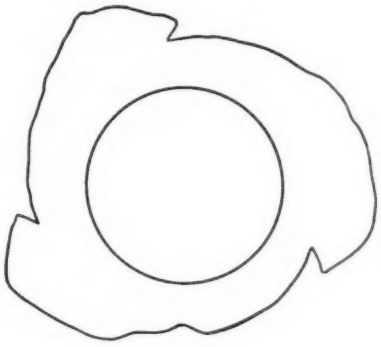


FIGURE 6
Siun-ki, 1000 B.C. Stockholm; Ostasiatiska Samlingarna.

near it. But a few centuries ago, this was not the case, and if we study the history of astronomical instruments, we find that the determination of the north pole has always occupied the astrologers. Three thousand years ago, no star of practical visibility was near it. The pole was somewhere between α Draconis and β Urs. Min. and about 6½ degrees from the latter, *i.e.*, 13 times the diameter of the moon (Fig. 3). How was then the pole found and the world's axis fixed?

If we look at Chinese celestial maps, which have not been modified during the last 1500 years, we see the pole strangely marked by four big stars, at the four corners of a square, which is crossed by two straight lines (Fig. 4). Around the pole, the maps show two rows of stars: the Chinese call them the Occidental Hedge (*si-fan*) and the Oriental Hedge (*toung-fan*). The latter, consisting of brighter stars, is much better defined. The only constellation common to the Chinese and the western uranography is the Great Bear, which the Chinese call the Bushel. One thousand years before our era, the brightnest stars (α, δ, ϵ, and ζ) of the Bushel, the whole Oriental Hedge and α Urs. Min. were all equidistant from the pole, at about 18°. A disk which would have had the form of the dotted line in Fig. 5 would, when placed at the proper distance from the eye, cover exactly the circumpolar region up to the most characteristic stars, which would then just be visible around its rim.

Now let us consider a jade disk (Fig. 6) presently kept in a Swedish collection, which at first sight seems to be without much meaning. If we compare it with the dotted line in Fig. 5, we see that it has exactly the same outline.

The usual *siun-ki* are not so clumsy. They are also not quite as old. I have examined about twenty such jade disks; their usual form is reproduced in Fig. 7. To hold them at the proper distance from the eye, the simplest way is to fix them on a tube of the appropriate length.

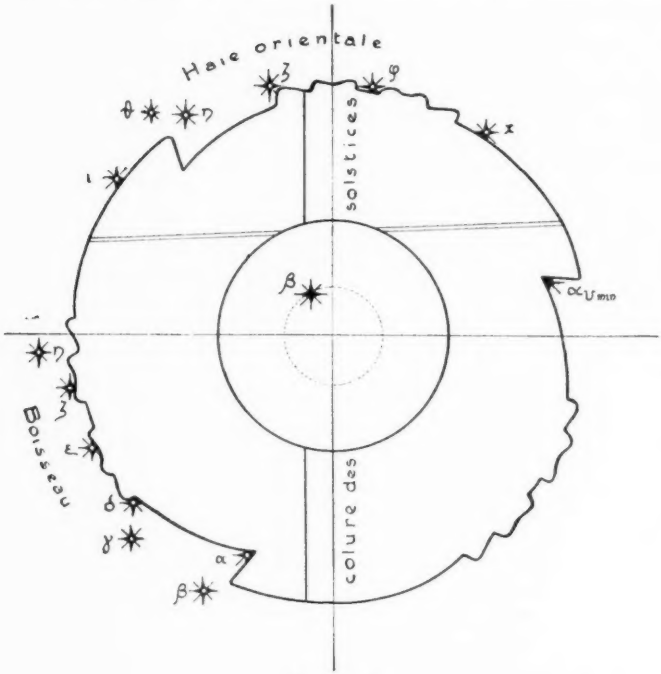


FIGURE 7
The *siun-ki* (Fig. 2) and the circumpolar stars of year 600 B.C.

FIGURE 8
The probable use of the *siun-ki*.

The *ts'ung* seems to have been made for that purpose, as its ends fit exactly the *ki's* central hole. We can thus use the combined instrument in the way which I have represented in Fig. 8, and then find that when the two main stars of the Bushel, α and β Urs. Maj., lie in the main indentation of the *ki*, the other stars also fit in its serrations. Then also the diametral straight line engraved on the *ki's* face shows the direction of the colure of solstices; the tube is in line with the world's axis, and the brightest star near the pole, β Urs. Min., moves along the internal periphery of the tube, the center of which shows the north pole (Fig. 7).

If we compute the dimensions which such a tube must have to fill its purpose, we find that these proportions correspond exactly with the specifications found in some ancient Chinese texts. These texts have always been misunderstood and wrongly interpreted, because one tried to relate them to "armillary spheres" or to "astrolabes," without succeeding, of course. The primitive *ts'ung*, dating from about 1000 years B.C., has precisely the computed proportions and can thus be identified with the mysterious ***hêng***.

Let us now examine the quaint representation of the north pole on Chinese celestial maps. I have said that the pole star moved along the interior rim of the tube. It could thus be observed in four successive positions, at intervals of 90 degrees. These intervals could be easily fixed, by rotating the square tube one-fourth around its axis: in each position, two of its faces would be in a vertical plane. When the guide-stars, α and β Urs. Maj., fell again in the same notch, it meant that an interval of six of our hours (*i.e.*, three Chinese hours, which are twice as long

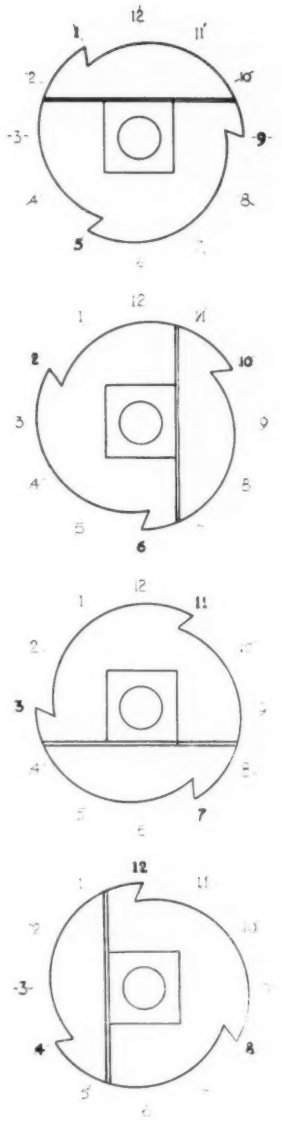


FIGURE 9
The four positions of the *sium-ki*.

as ours) had elapsed, and that the displacement of β Urs. Min. corresponded to an angle of 90° around the pole. One of the earliest astronomical treatises, the Chou-Pei, calls explicitly the *sium-ki* "the Instrument of the four Displacements." The double line traced on the disk *ki*, being tangent to one of the *hêng's* faces (Fig. 9) helps to show these four successive positions.

The north pole, being in the center of the square formed by the four positions of β Urs. Min. can be located by a cross in the center of this square.

But there is more: let us consider Fig. 9; it enables us to understand the purpose of the triple repetition of the *ki's* teeth. When the instrument lies in its first position, with the double line horizontal and above the tube, the three main teeth indicate three hour-angles which I have marked 1, 5, and 9 on Fig. 9. By turning the whole instrument clockwise until the double line is in a vertical plane and to the right of the *hêng*, the same three teeth show the hours 2, 6, and 10; one quarter-turn more, and the teeth mark 3, 7, and 11; finally with the double line up and down and to the left of the tube, the teeth show 4, 8, and 12. If the "guards" (α and β Urs. Maj.) lie in one of the notches, the *sium-ki* marks the position of these stars at regular intervals of one Chinese hour. It can thus be used for knowing the time by night.

It is quite interesting to note that a very modern instrument, the theodolite with meridian prism, has been devised to fulfill exactly the same purpose: the determination of the pole by comparison with a circumpolar star, and the observation of the (sidereal) time by measurement of this star's hour-angle. Nothing new under the sun!

BRUSSELS (BELGIUM); 54 RUE DE TENBOSCH, OCTOBER, 1949.

The Planets in June, 1950

By RAYMOND H. WILSON, JR.

NOTE: The time employed is Central Standard Time unless otherwise indicated. The phenomena have been chosen and described for the North American continent, and especially for the United States. The basic data have been taken principally from the *American Ephemeris and Nautical Almanac*.

Sun. During most of this month the sun will stand within a half degree of its northernmost possible position in the sky. This extreme position, called the summer solstice, will occur on June 21 at 6 P.M.

Moon. The phases of the moon will occur as follows:

Last Quarter	June 7	6 A.M.
New Moon	15	10 A.M.
First Quarter	22	11 P.M.
Full Moon	29	2 P.M.

The moon will be nearest to the earth on June 27.

Evening and Morning Stars. Saturn and Mars will be visible in the southwest after sunset; Jupiter and Venus, in the morning sky.

Mercury. Since Mercury will be nearly 24 degrees west of the sun on the 9th, it should be visible low in the eastern dawn, except during the last week or so of the month.

Venus. This brilliant planet will be rising in the east at about 3 A.M.

Mars. Mars will be rapidly decreasing in brightness, and accelerating its eastward motion among the stars of Virgo in the evening sky.

Jupiter. Jupiter will be rising in the southeast before midnight by the end of the month.

Saturn. Saturn in Leo will be still high above the western horizon after sunset; so there is plenty of chance for good views of it before conjunction with the sun. On the evening of June 21 the moon will be passing less than a degree to the south of the planet.

Uranus. Since the sun will pass conjunction with it on the 27th, Uranus will be practically unobservable this month.

Neptune. Neptune will be almost stationary, a few minutes south of 44 Virginis.

Department of Mathematics, Temple University, Philadelphia, Pa.
April 12, 1950.

Asteroid Notes

By HUGH S. RICE

We offer positions for several asteroids which are observable at this time, including two of the large ones. The ephemerides are taken from the American minor-planet annual; but an examination of the Russian set of places shows that there is a close agreement between the two sets, for corresponding dates. With each asteroid, however, the positions for the last date are done by us by extrapolation procedure, in order to extend the ephemeris another 10 days.

2 Pallas is at opposition May 13, and during the period of the apparition is in or near the northwestern corner of Serpens Caput, moving into Boötes in May. The photo-magnitude is about 8.2. 354 Eleonora is found mostly in western Serpens Caput, the opposition date being May 14, and computed magnitude 9.9. 11 Parthenope, located mostly in southwestern Ophiuchus, is at opposition June 2, at magnitude 9.0. 21 Lutetia is in southern Ophiuchus, with opposition June 3, and magnitude 9.7. Giant Ceres, the greatest of all minor planets, is also in southern Ophiuchus, a little north of Lutetia, and indeed in July the two planets are very close in apparent position, as a comparison of the declinations shows. There is much difference in their magnitudes, Ceres' being given as 7.5. The opposition date of Ceres is June 4. 10 Hygiea is in the same constellation, at magnitude 9.0 with opposition date June 7. Hygiea was for many years spelled *Hygeia*, as per the original way, as can be seen in many of the old astronomy books of the 19th century. In fact, quite a number of the names have been slightly altered over their original spelling, which would likely not be allowed in zoological circles.

ASTEROID EPHEMERIDES
0h U.T. Equinox 1950

2 PALLAS

1950	α h m	δ ° ′
May 9	15 20.2	+25 7
19	15 11.9	+26 3
29	15 4.4	+26 22
June 8	14 58.5	+26 7
18	14 55.0	+25 22

354 ELEONORA

1950	α h m	δ ° ′
May 9	15 27.5	+10 51
19	15 19.3	+11 11
29	15 11.7	+11 5
June 8	15 5.5	+10 32
18	15 1.5	+ 9 32

11 PARTHENOPE

1950	α h m	δ ° ′
May 9	16 59.6	−15 56
19	16 52.2	−15 40
29	16 43.1	−15 28
June 8	16 33.3	−15 21
18	16 24.0	−15 21
28	16 16.4	−15 30
July 8	16 11.7	−15 50

21 LUTETIA

1950	α h m	δ ° ′
May 9	17 4.2	−21 25
19	16 57.1	−21 26
29	16 47.7	−21 25
June 8	16 37.3	−21 22
18	16 27.3	−21 18
28	16 19.0	−21 14
July 8	16 13.7	−21 9

1 CERES

1950	α h m	δ ° ′
May 9	17 8.8	−19 13
19	17 1.3	−19 31
29	16 52.2	−19 50
June 8	16 42.6	−20 9
18	16 33.3	−20 28
28	16 25.5	−20 48
July 8	16 20.2	−21 8

10 HYGIEA

1950	α h m	δ ° ′
May 9	17 22.7	−26 23
19	17 16.9	−26 13
29	17 9.3	−25 59
June 8	17 0.9	−25 37
18	16 52.5	−25 12
28	16 45.1	−24 43
July 8	16 39.7	−24 9

Hayden Planetarium, American Museum of Natural History, New York.
1950 April 20.

Occultation Predictions for June, 1950

(Taken from the *American Ephemeris*)

The quantities in the columns *a* and *b* are given for the purpose of making these predictions useful for any place within 200 miles of the point indicated. The procedure is as follows: Subtract the longitude of the point given from the longitude of the place in question; multiply the result in degrees, taking the signs into account, by the quantity under *a* for the star to be observed; similarly, with the latitude, using *b*; apply the sum of the products, with its proper sign, to the Greenwich C.T., and obtain the predicted Greenwich Civil Time for the phenomenon at the place of observation. To obtain Eastern Standard Time it is necessary to subtract five hours; Central Standard Time, six hours, etc.

			IMMERSION				EMERSION			
Date 1950	Star	Mag.	Greenwich C.T. h m	*a* m	*b* m	Angle E from N °	Greenwich C.T. h m	*a* m	*b* m	Angle E from N °
OCCULTATIONS VISIBLE IN LONGITUDE +72° 30′, LATITUDE +42° 30′										
June 4	56 B.Capr	6.3	8 56.1	−1.9	0.0	83	10 8.7	−1.0	+0.4	222
6	50 Aqar	5.9	8 57.8	−0.8	+2.0	15	10 1.8	−2.5	0.0	274
13	η Taur	3.0	14 29.0	..	..	356	15 0.9	..	..	312
28	CD−27°11076	6.5	1 37.7	−1.6	+0.5	96	2 52.0	−1.6	−0.3	297

Date 1950	Star	Mag.	IMMERSION Greenwich C.T.	*a*	*b*	Angle E from N	EMERSION Greenwich C.T.	*a*	*b*	Angle E from N
			h m	m	m	°	h m	m	m	°
Occultations Visible in Longitude +91° 0′, Latitude +40° 0′										
June 4	56 B.Capr	6.3	8 19.1	—1.8	+1.1	68	9 41.2	—1.8	+0.6	245
6	50 Aqar	5.9	8 42.3	..	..	347	9 6.5	..	..	314
28	CD—27°11076	6.5	1 16.2	—0.6	+0.2	128	2 21.6	—1.5	+0.7	272
Occultations Visible in Longitude +98° 0′, Latitude +31° 0′										
June 4	56 B.Capr	6.3	7 56.1	—2.0	+1.1	80	9 19.5	—2.1	+1.2	239
6	50 Aqar	5.9	8 4.1	—1.0	+3.3	10	8 51.1	—1.9	0.0	296
6	182 B.Aqar	6.2	11 47.8	—2.4	+0.8	70	13 7.3	—0.9	+1.7	207
23	319 B.Virg	6.3	23 50.6	—2.9	+0.7	88	0 46.2	—0.1	—2.8	358
28	CD—27°11076	6.5	1 22.5	+1.1	—2.4	173	1 54.7	—2.9	+2.8	231
Occultations Visible in Longitude +120° 0′, Latitude +36° 0′										
June 4	56 B.Capr	6.3	7 32.4	—0.9	+1.4	81	8 44.2	—1.4	+1.3	252
6	182 B.Aqar	6.2	11 18.2	—1.2	+2.3	26	12 32.7	—2.4	+0.6	264
28	134 B.Scor	6.4	1 51.5	—1.1	+1.9	70	2 37.9	+0.1	—0.7	331

METEORS AND METEORITES

Meteor Notes from the American Meteor Society

By CHARLES P. OLIVIER, President

In submitting the annual report of the Society for 1949 it will at once be remarked, by those who have read former ones, that the total of ordinary meteors is considerably smaller than usual. This is largely due to moonlight and bad weather at the maxima of several of the chief showers, particularly for the Perseids. For these, we often have several thousand meteors reported by casual observers, who have generally made hourly counts only. This not being the case in 1949 largely cut down our annual total. On the contrary, our results were more valuable than usual due to the large percentage of meteors which were plotted and fully observed, particularly by some our experienced members. Also 220 meteors telescopically observed were reported, which will be used in another paper on the subject when enough data have been gathered. Fireballs A.M.S. Nos. 2315, 2316, 2317, 2318, 2319, and 3548 were fully written up in Meteor Notes, with their atmospheric paths derived; for two of them their parabolic orbits were also computed. Radiants A.M.S. Nos. 3035 to 3057 inclusive were derived and published. A paper covering over three thousand telescopic meteor observations, reported to us, was read at the Ottawa meeting of the American Astronomical Society during the symposium on meteoric astronomy, last June. This paper, enlarged and somewhat emended, and with a second part dealing with the magnitudes of naked-eye meteors, has been submitted for publication and we hope that it will shortly appear. It will hence be seen that much use has been made of observations reported to the A.M.S., and that in 1949 quite a good deal was prepared for publication. The Meteor Notes for 1949 appear as Reprint No. 77 of the Flower Observatory. A copy has been sent to every member who has paid his 1950 dues and who had joined in time to have a part in the 1949 work. During 1950 we hope to reduce a considerable amount of back work, and it is being done as rapidly as assistance and time are available.

We continue to request the active cooperation of all observers who use telescopes in recording telescopic meteors, seen by them in the course of their work.

New members: The following is a list of names and addresses of persons who have joined the A.M.S. since our last list was printed in Meteor Notes for January, 1947, and who have paid their 1950 dues and/or contributed observations since they joined. I have not listed 39 persons who have done neither, and they are no longer considered members.

Forsyth, E. L., R.R. 1, Box 7, Fall Brook, Calif.
Skumanick, A., 192 Nicholson St., Wilkes Barre, Pa.
Widner, R., 3680 S.E. Glenwood Ave., Portland, Ore.
Bybee, G. F., Columbia, Ky.
Mayer, E., 41 Laird Ave., Buffalo 7, N. Y.
Eason, Mrs. F. B., P. O. Box 348, Wilson, N. C.
Wright, G. R., 9922 Lorrain Ave., Silver Springs, Md.
Turnbull, H. S., Jr., Box 553, Seal Harbor, Maine
Bachman, J. R., 2540 N. 53 St., Omaha, Neb.
Sky Scanners, % Hayden Planetarium, New York, N. Y.
Pierce, L. W., 408 Du Page, Elgin, Ill.
Knowles, J., Pierce St., Marblehead, Mass.
de Kort, W., St. Antonius lie 85, Antwerp, Belgium.
La Belle, C. W., 38 W. Main St., Macedon, N. Y.
Lankford, J. E., 3118 Central Ave., N.E., Washington 18, D. C.
Tifft, W. G., 53 Swan Ave., Seymour, Conn.
Worley, C. E., 281 Filmore St., Ottumwa, Iowa.
Kaeppel, C., 3911 Swarthmore St., Houston 5, Texas.
Linsley, Prof. E. G., 4150 39 Ave., Oakland 2, Calif.
MacQueen, Dr. J. W., 3148 Pine Ridge Rd., Birmingham, Ala.
Griswold, D. E., 532 Westfield Rd., Scotch Plains, N. J.
Buchanan, L. K., R.R. 10, Box 318, Tulsa 15, Okla.
Peabody, J. J., 642 Edgebrook Terrace, Elgin, Ill.
Braswell, D., 1101 Herring Ave., Wilson, N. C.
Burt, P., 3847 Tutwiler, Memphis, Tenn.
Bissette, W. E., 1103 Herring Ave., Wilson, N. C.
Johnson, C. E., 102 State St., Schnectady, N. Y.
Motley, G., 35 Beverly Rd., W. Caldwell, N. J.
Barnes, P., Lyallpur, Pakistan.
Strayhorn, D., 527 S. Front St., Wilmington, N. C.
Ange, F., 217 Broad St., Wilson, N. C.
Bissette, L., 512 Oak Ave., Wilson, N. C.
Austin, Mrs. M. F., Wynnewood Park Apts., Wynnewood, Pa.
Keysar, F. A., 415 N. Ashland Ave., La Grange, Ill.
Barringer, B., Villanova, Pa.
Barringer, D. M., 1528 Walnut St., Philadelphia, Pa.
Brown, L. E., P.O. Box 36, Greenville, N. C.
Agor, T., 40 Williams St., Worcester 2, Mass.
Gills, Mrs. T. J., Trinity Drive, Wilson, N. C.
Davis, M., 1422 Rhode Island Ave., Washington 5, D. C.
Morrow, P. E., 504 University Park, Rochester 7, N. Y.
Brown, L. B., 601 Main St., Parkville, Mo.
Russell, A., 3140 N.W. 20 St., Oklahoma City, Okla.
Miller, D. N., 4314 10 St., Washington 17, D. C.
Snyder, Lt. T. R., Jr., Box 355 Castle Air Force Base, Merced, Calif.
Cisler, E., 2819 S. Highland Ave., Berwyn, Ill.
Retano, S., Sec. Off., S.S. Evergreen State, % 90 Broad St., New York, N. Y.
Adams, R. T., 301 Highway, Riverton, N. J.
Peart, D. J., 1223 Woodland Ave., Pittsburgh 12, Pa.
Yakima Amateur Astron., 324 W. Yakima Ave., Yakima, Wash.
Gentry, W., 618 Linden Ave., Elizabethton, Tenn.

TELESCOPIC METEORS

Cain, C. V., Minneapolis, Minn.	3
Fernald, C. F., Wilton, Maine	90
Flower Observatory, Upper Darby, Pa.	6
Johnson, L. T., Blossom Point, Md.	8
Lankford, J. E., U. S. Naval Observatory	3
Oravec, E. G., New York, N. Y.	9
Oravec, E. G., 1943-1947	51
Peltier, L. C., Delphos, Ohio	24
Penhallow, W., Woonsocket, R. I.	9
Rosebrugh, D. W., Waterbury, Conn.	4
Tifft, W. G., Seymour, Conn.	10
Total telescopic	220

Observer and Station	Nights	Meteors	
Anderson, R., Chicago, Ill.	4	54	C
Ange, F., Wilson, N. C.	4	97	D
Anyzeski, V., East Haven, Conn.	11	201	P
Ayres, C. C., Ottumwa, Iowa	2	45	C
Barnes, P., Lyallpur, Pakistan	80	803	P
Becker, H., Philadelphia, Pa.	2	30	
Bissette, L., Wilson, N. C.	4	45	D
Bissette, W., Wilson, N. C.	23	917	P*
Bissette, W., and Braswell, D. K., Wilson, N. C.	7	90	P
Burt, P., Memphis, Tenn.	13	196	P
Darling, B., Lansing, Mich.	2	26	C
de Kort, W., near Antwerp, Belgium	8	119	P
Dole, R. M., Cape Elizabeth, Me.	35	379	P
Dupee, Mrs. D. S., Strafford, N. H.	8	149	D
Eason, F. B., Wilson, N. C.	17	324	P
Eason, Mrs. F. B., Wilson, N. C.	16	165	P
Gentry, W., Elizabethton, Tenn.	6	140	P
Gill, Miss J. R., Northampton, Mass.	1	30	P
Griswold, D. E., Middletown, Conn.	1	29	
Jensen, Miss A. K., Silverton, Ore.	14	229	C
Johnson, L. T., Blossom Point, Md.	2	29	P
Khan, Mohd. A. R., Begumpet, India	111	631	P
Keysar, F. A., La Grange, Ill.	2	29	P
Knowles, J., Marblehead, Mass.	23	572	P
Motley, G., N. Caldwell, N. J.	14	81	P
Naylor, C. D., Norristown, Pa.	5	75	P
Oravec, F. G., New York, N. Y.	3	25	D
Painter, Wm., Wilson, N. C.	2	87	D
Peabody, J. J., Elgin, Ill.	4	62	P
Scott, T., Nauvoo, Ala.	2	37	P
Skinner, G. B., Brockton, Mass.	3	37	D
Sky Scanners, Bronx, N. Y.		122	P
Speer, P. C., S.S. Monitor		39	P
Swihart, T., Elkhart, Ind.	2	43	P
Waln, Rev. Y. O., Leesburg, Ohio	5	29	P
Weitzenhoffer, K., New York, N. Y.	4	31	P
Widner, R., Portland, Ore.	12	217	P
Worley, C. E., Ottumwa, Iowa	43	925	P
Observers with less than 20 each	22	171	
Total		7310	
Telescopic meteors		220	
Fireballs		210	
Grand total for 1950		7740	

Notes: In the last column P means that the meteors were plotted, D that they were described individually, C that counts—usually on an hourly basis—were made; * the numbers are subject to revision.

Blanks will be furnished on demand. Everyone is also requested to observe and promptly report every fireball which is seen, most particularly if it has left a long-enduring train. We are still most interested in the latter. Observations on the same object, made in two or more distant places, often permit us to compute the path. Our regular members are urged to emulate the example of the few who send in such excellent annual totals. Remember that the only way to become a *skilled* observer is to actually spend hours observing and plotting. We wish to especially commend the Wilson, N. C., observers who, under our able regional director, F. B. Eason, did such outstanding work in 1949. What was accomplished by individuals is clearly shown in the accompanying tables. New members are always welcome *provided* they intend to do some real work for the Society, *i.e.*, observe a reasonable amount. Besides to individuals, the daily press, and the radio, we are as always under special obligation to the Hydrographic Office, United States Navy, for their invaluable aid in encouraging observations by ships' officers and then publishing the results in the *Hydrographic Bulletin*, which may be obtained by any interested person.

In closing, the hope is expressed that our active members will continue their good work during 1950 and that the very numerous inactive or partially active ones will have a change of attitude and an accession of industry so that among us all 1950 will be a most successful year for the Society.

Flower Observatory of the University of Pennsylvania, Upper Darby, Pa.
1950 March 14.

Contributions of The Meteoritical Society

(Known Formerly as The Society for Research on Meteorites)

Edited by FREDERICK C. LEONARD
Department of Astronomy, University of California, Los Angeles 24

The Discovery of an Additional Sams Valley, Oregon, Meteorite (ECN = + 1229,425)

RUSSELL A. MORLEY
399 North 18th Street, Salem, Oregon

ABSTRACT

The discovery, in the summer of 1949, of an additional Sams Valley, Oregon, meteorite (ECN = + 1229,425; cl. = Om) on the Frank B. Payne property, near Beagle, Jackson County, Oregon, in the Trail Quadrangle, is announced. This meteorite was found by Mr. Payne's father in the late 1800's, but has never before been reported. It is now on display in the Jacksonville Museum. The specimen measures 12.5 × 4.5 × 4 cm. (overall dimensions), and has a specific gravity (sp. gr.) of 6.82 and a hardness of 5.5-6.0, and weighs about 1028 gm.

In the summer of 1949, while engaged on a collecting expedition in southern Oregon, I visited the Jacksonville Museum in the hope that I might obtain some information regarding the exact location of the Sams Valley, Jackson County,

meteoritic fall (ECN = + 1230,424; cl. = Om). I was unable to secure any information regarding the exact location other than what was to be obtained from the ECN (equatorial coördinate number) = + 1230,424, taken from "A Catalog of the Meteoritic Falls of the 11 Western States," by Dr. Frederick C. Leonard and Miss Dorothy H. Alley, which appeared in *C.M.S.*, **4**, 58-65; *P. A.*, **55**, 381-8, 1947. That ECN would place the location of the find somewhere in the middle of Sams Valley.

While looking over the collections of the Jacksonville Museum, I asked the keeper, Mr. J. B. Noble, whether the Museum had any meteorites in its collections. He showed me a large specimen labeled *meteorite*, which, on examination, proved to be an oddly shaped specimen of weathered diorite that had been covered with orange shellac in order to give it something of the appearance of a meteorite! While I was engaged in this examination, my mother was carefully examining the mineral collection, in which she located 3 specimens bearing a card labeled *meteorites*. On first examination, 2 of the 3 specimens proved to be magnetite. The third appeared to be a meteorite. With the coöperation of Mr. H. A. Berntson, the local machinist, I removed a slice, which I polished and etched. The Widmanstätten pattern proved to be that of a medium octahedrite (Om). I took the meteorite to the local store, where I found that it weighed approximately 2 lb., 4½ oz. = 1028 gm. The overall dimensions of the specimen are 12.5 × 4.5 × 4 cm.

On the completion of this work, I set out to locate, as nearly as possible, the exact location of the Sams Valley find. The great majority of the people in the area either were newcomers or had never heard of any meteorites there. After a long and careful search, I happened, by good fortune, to locate the property of Mr. Frank B. Payne, of 524 Evelyn Avenue, Albany 6, California. He was then visiting his nephew, Mr. Andrew Payne, who now resides on the family property. Mr. Frank Payne, at the time I met him, was showing some friends the places where he and his father had mined. He was most kind in relating the history of his father's discovery, which at the time was considered to be of little importance and was therefore never reported. One day while Mr. Payne's father, Mr. W. M. Payne, was engaged in panning in a small gulch on his property, he found, in the bottom of his pan, a piece of heavy material that, when washed off and rubbed with a file, appeared to be iron; a little farther up the gulch he encountered the specimen now in the Jacksonville Museum. At a short distance still farther up he came upon an even larger specimen; this specimen he gave to a friend, by the name of Edward Cooper, whom I have been unable to locate.

The sample that I removed from the original meteorite in the Jacksonville Museum I compared with a known specimen from Sams Valley in the collection of Dr. J. Hugh Pruett of Eugene, Oregon. Both he and Dr. Kunz of the Department of Chemistry of the University of Oregon agreed with me in that Dr. Pruett's specimen and the sample from the Jacksonville Museum were from the same fall. We forwarded the 2 specimens to Dr. Frederick C. Leonard of the Department of Astronomy of the University of California, Los Angeles, for further examination. Both Dr. Leonard and Dr. Joseph Murdoch of the Department of Geology of that institution examined the specimens, and Dr. Leonard reported that, in their opinion, the 2 meteorites are members of the same fall. These statements, in addition to my observations and Mr. Payne's testimony, leave little doubt that the Sams Valley fall was a multiple fall or a shower; until the weather improves, however, search for more individual meteorites will have to be postponed.

Mr. Payne, in my presence, named the gulch "Meteorite Gulch." It is located

on the Payne property, on a bend of Sams Creek, on the north bank and about 10 feet above the stream, at low-water stage. The gulch runs for several hundred feet up the slope of the hillside, which is now well covered with brush and timber. The specimens were recovered at bedrock, in the bottom of the gulch, which is not more than 10 feet wide at the top and forms a V-shaped trough at the bottom. The exact location is in the N. W. ¼ of the S. E. ¼ of Sect. 13 T 35 R 2-3W., on the Frank B. Payne property on Sams Creek near Beagle, Jackson County, Oregon, in the Trail Quadrangle. The benchmark 1347 marks the corner of Sect. 13. The longitude is approximately W. 122° 52′ 30″, and the latitude N. 42° 31′ 46″. On the basis of this position, the equatorial coördinate number (ECN) of the fall should be changed from + 1230,424 (as given in Dr. Leonard's "A Catalog of Provisional Coördinate Numbers for the Meteoritic Falls of the World," *Univ. of New Mexico Publ. in Meteoritics*, No. 1, p. 44, 1946) to + 1229,425.

The following 2 comparisons (Table 1) are based upon a known specimen of the Sams Valley fall in the collection of Dr. J. Hugh Pruett and the specimen removed from the meteorite in the Jacksonville Museum and now in my collection.

TABLE 1

PROPERTIES OF 2 SAMS VALLEY METEORITES

Specimen in the Collection of J. H. Pruett	*Specimen in the Collection of R. A. Morley*
Sp. gr.: 6.61	Sp. gr.: 6.82
Hardness: 5.5-6.0	Hardness: 5.5-6.0
Inclusions: Schreibersite	Inclusions: Schreibersite
Width of Widmanstätten bands = 0.5-0.9 mm.; cl. = Om	Width of Widmanstätten bands = 0.5-0.8 mm.; cl. = Om
Oxide streak: Red-brown	Oxide streak: Red-brown

Graduate Work in Meteoritics at the University of New Mexico

In a private letter dated 1950 March 21, Dr. Lincoln LaPaz, the Director of the Institute of Meteoritics of the University of New Mexico, Albuquerque, writes: "No doubt you will be interested to know that Dr. Carl W. Beck and I now have 3 candidates for the master's degree, working on meteoritical investigations. These young men will take their degrees jointly under the auspices of the Department of Geology and the Institute of Meteoritics. I believe that I am right in saying that these students are the first to be working for the master's degree in meteoritics in the United States. Can you tell me whether this is true?" As far as my knowledge extends, it is. Dr. LaPaz and Dr. Beck and likewise the University of New Mexico are to be congratulated on having probably the first students working towards the master's degree in meteoritics, "the science of meteorites and meteors."

For a number of years now, at the University of California, Los Angeles, an upper-division course in meteoritics (cataloged as "Astronomy 118") has been given by the undersigned regularly during the spring semester of each academic year and also during several of the summer sessions. The enrolments in this course, which is open to junior, senior, and graduate students majoring in a physical science or mathematics, have been most encouraging, not only in the regular sessions but likewise in the summer sessions. The enrolment in the current

class in meteoritics (by no means the largest one of its kind on record) is 13 students, of whom 8 are mathematics majors, 4 are geology majors, and 1 is a chemistry major.—F.C.L.

President of the Society: ARTHUR S. KING, 925 Topeka Street, Pasadena 6, California

Secretary of the Society: JOHN A. RUSSELL, Department of Astronomy, University of Southern California, Los Angeles 7, California

VARIABLE STARS

Variable Star Notes from the American Association of Variable Star Observers

By MARGARET W. MAYALL, Recorder

UV Persei, 020356. Fernald made 3 observations of a maximum of this U Geminorum-type star on JD 2433345, 346, and 348, 12.2 magnitude at maximum. UV Persei is usually below the limit of visibility of most telescopes, but has rapid rises to maxima at intervals of 140 to 400 days.

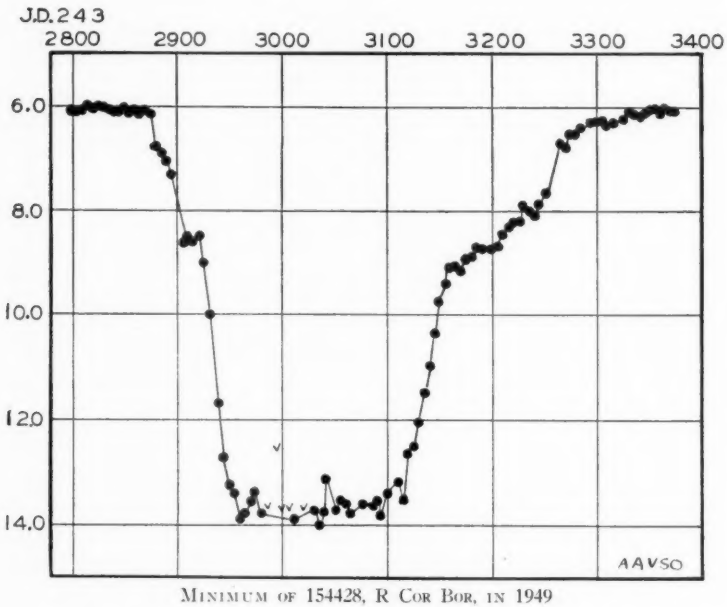
Z Camelopardalis, 081473. Z Camelopardalis appears to be starting a period of activity once more. The last of February it reached a maximum of 10.4 magnitude. Ten days before, and again 15 days later, it was down to 13.2 magnitude. By the last of March it had increased to 12th magnitude. Z Camelopardalis has been practically stationary since April, 1948, a period of about 670 days, with only a few slight indications of variability.

S Apodis, 145971. S Apodis has remained around 10.8 to 11.0 magnitude from December, 1949, through February of this year. It has not reached its normal maximum brightness of 10th magnitude.

R Coronae Borealis, 154428. R Cor Bor has now reached its normal brightness, around 6th magnitude. The accompanying diagram shows the light curve of the minimum of 1949, as plotted from the 5-day means. The curve is a continuation, with some overlapping, of the curve given by Mr. Campbell in the POPULAR ASTRONOMY Variable Star Notes for March, 1949. This 1949 minimum is the widest and deepest one that has occurred since the very great activity during the period from 1863 to 1874. At that time, the observations by Baxendell, Schoenfeld, and Schmidt showed it near minimum most of the time, with some short rapid fluctuations up to the 8th magnitude. As can be seen from the light curve in the figure, R Cor Bor stayed near the 14th magnitude for about 150 days in 1949.

R Vulpeculae, 205923a. R Vulpeculae had a maximum around December 20 of brighter than the 8th magnitude. The previous maximum in the middle of August was a magnitude fainter.

SS Cygni, 213843. Axel V. Nielsen of Aarhus, Denmark, has recently sent in 172 observations of SS Cygni made by 8 members of the Scandinavian Astronomisk Selskab during 1949. Before the war, Mr. Nielsen always sent Mr. Campbell the Society's observations of SS Cygni for him to use in his yearly mean light curves. I am delighted to have this exchange of observations renewed, but I regret that I could not include them in the means published in the Variable Star Notes of February, 1950. Many of the observations help determine the shapes of the 1949 maxima, but in each case they confirm the classification given in the notes.



MINIMUM OF 154428, R COR BOR, IN 1949

Another maximum (No. 377) of SS Cygni was observed the last of March by 3 observers, Charles, Fernald, and Ford, at about the 9th magnitude.

Nova Lacertae 1950, 224552. The most recent information about Nova Lacertae is a single observation of 9.7 magnitude made by Ford on April 7. It is getting too low in the evening sky for most observers, but it is high enough in the morning for an all-night enthusiast to catch it then. The light curve of the nova seems very similar to that of DQ Herculis 1934 and V732 Sagittarii 1936, and it should be followed very carefully to watch for a possible sudden drop in brightness.

Observations received during March, 1950: A total of 2,841 was received during the month from 53 observers, as follows:

Observer	No. Var.	No. Ests.	Observer	No. Var.	No. Ests.
Adams	31	75	Dillon	6	12
Ahnert	28	97	Drakakis	17	34
Ancarani	24	43	Edmonds	12	12
Bogard	44	102	Escalante	95	160
Buckstaff	6	6	Estremadoyro, V. A.	6	10
Burkhead	2	3	Fernald	108	147
Cain	7	7	Ford	36	36
Chandra	143	211	Galbraith	10	11
Charles	19	19	Greenley	69	128
Cooke	11	26	Hamilton	2	3
Cragg	27	27	Hartmann	114	118
Diedrich, D.	1	1	Herring	9	9
Diedrich, G.	1	1	Holloway	4	4

Observer	No. Var.	No. Ests.	Observer	No. Var.	No. Ests.
Kelly, F. J.	11	11	Peter	5	21
Knowles	20	39	Renner	35	35
de Kock	98	425	Rick	1	1
Lacchini	86	142	Rosebrugh	14	83
Lankford	14	52	Stevens	20	25
Leutenneger	9	30	Taboada	72	79
LeVaux	23	23	Tifft	1	1
Luft	5	9	Toche	9	10
Melville	10	22	Upton	32	40
Meyer	8	10	Venter	17	32
Oravec	68	186	Waters	2	3
Parker	23	25	Welker	3	6
Pearcy	95	102	—		—
Peltier	59	91	53	Totals	2,841
Penhallow	27	36			

Nova Search: Reports on the Nova Search Program were received during March from 6 observers on areas as follows:

Adams: 16, 17, 33, 34, 53, 54.
Diedrich, D.: 94.
Diedrich, G.: 56.
Luft: 25, 26, 27, 33, 34, 35.
Rosebrugh: Dome, 1, 34.
Smith, F. W.: 3, 4.
April 15, 1950.

Comet Notes

By G. VAN BIESBROECK

Owners of small telescopes have no opportunity to watch known comets at this time but should not forget that most new comets appear unexpectedly and that many have been first seen by amateurs.

While no new comets have been announced this year several faint ones remain in reach of large telescopes. Aside from the yearly observed periodic comets, SCHWASSMANN-WACHMANN No. 1 and OTERMA, these have been found in 1949 and even 1948 and may be followed for some time. The brightest among these is COMET JOHNSON (1949 *a*) for which an ephemeris was given last month. On April 11 I found it about a magnitude fainter than the predicted value. It showed a well-defined nucleus in a diffuse round coma of about one minute of arc in diameter. Visibility will continue for several months.

The search for PERIODIC COMET D'ARREST, both at the Lick and the Yerkes Observatory, has not yet led to the recovery of this expected object. Presumably it remains much fainter than expected. However, both the location and the brightness improve in the coming months so that recovery is expected soon. Maximum brightness occurs shortly after the perihelion passage on June 6.

McDonald Observatory, 1950 April 12.

Communications and Comments

Under this heading we shall publish from time to time such material as does not properly fall under any of the established headings of this journal. Here, too, may be found, when occasion arises, articles which the editor may not be willing to give sanction to but which, nevertheless, may be provocative of thought along new lines.

In the October, 1949, issue, beginning on page 386, under the title "The Teaching of Astronomy" we printed one of the items used by Dr. George Eby of the Stockton Junior College, Stockton, California, as inspirational material at the beginning of the period of his class in astronomy. Another such item follows. EDITOR.

Omar Khayyam, The Astronomer-Poet of Persia

Omar Khayyam lived during the dark ages of Europe. The thinking of man was confused. The religion of Persia was giving way to Mohammedanism. Few there were, who could see purpose and order in the universe. Even Omar, the mystic poet and philosopher of the East, was often frustrated by his inability to see into the beyond. Consequently much of his poetry expresses a day to day attitude of which the following stanza is typical:

"How sweet is mortal Sovranty—think some,
Others—How blest the paradise to come,
Ah, take the cash, and let the credit go,
Nor heed the rumble of a distant drum."

Yet beneath most of his poetry there is a deep appreciation of *time* in the universe. *Time* is one of the most difficult concepts for Astronomy students to grasp, so do not look upon his poetry as morbid or always speaking of death. Instead, think of it as an effort to contrast the shortness of our lives with the infinite time of the heavens. As the following stanzas are read, watch for the constant references to time and see if you too can join with Omar Khayyam in feeling that invisible something which permeates all things in the universe.

"Awake, for morning in the Bowl of Night
Has flung the stone that puts the stars to flight,
And Lo: the hunter of the east has caught
The Sultan's Turret in a noose of light.

Dreaming when dawn's left hand was in the sky
I heard a voice within the tavern cry,
Awake, my little ones and fill the cup
Before life's liquor in its cup be dry.
When all the temple is prepared within
Why nods the drowsy Worshipper outside?

And, as the Cock crew, those who stood before
The Tavern shouted—"Open then the Door!
You know how little while we have to stay,
And, once departed, may return no more."

The Bird of Time has but a little way
To fly—And Lo! the Bird is on the Wing.

The Worldly hope men set their Hearts upon
Turns Ashes—or it prospers; and anon,
Like snow upon the Desert's dusty face
Lighting a little hour or two and then is gone.

Think, in this batter'd Caravan
Whose doorways are alternate night and day,
How Sultan after Sultan with his Pomp
Abode his Hour or two, and went his way.

Ah! my Beloved, fill the cup that clears
Today of past regrets and future fears
Tomorrow?—Why, tomorrow I may be
Myself with yesterday's Sev'n thousand years.

And when the Angel with his darker drought
Draws up to thee—take that, and do not shrink.

Lo! Some
Have drunk their cup a round or two before
And one by one crept silently to rest.

When you and I behind the veil are past,
Oh, but the long, long while the world shall last,
Which of our Coming and Departure heeds
As the Sea's self should heed a pebble-cast.

Ah, make the most of what we yet may spend,
Before we too into the dust descend."

Omar Khayyam studied Astronomy without benefit of telescope or camera. Naturally, his vision was limited and his thinking perplexed. However, we can sympathize with him when he yearns for a glimpse into the infinite and when he tries to find a key which will unlock the door to the mysteries of the universe. Yet throughout many of his poems we can feel a deep expression of vastness in that inverted bowl he called the sky. He sensed the omnipotent greatness of the star studded heavens even though he did not understand it or appreciate its purpose. So, while you listen to the next group of his poems do not let his conclusions affect your thinking prematurely, but instead try to fathom those invisible depths through which he was struggling. And perhaps *you* may be the key which shall unlock the door he was groping without.

"Myself when young did eagerly frequent
Doctor and Saint, and heard great argument,
About it and about: but evermore
Came out by the same door as in I went.

With them the seed of wisdom did I sow,
And with my own hand labour'd it to grow:
And this was all the harvest that I reap'd—
I came like water, and like wind I go.

Into this Universe, and *Why* not knowing
Nor *Whence*, like water willy-nilly flowing:
And out of it, as wind along the waste,
I know not *Whither*, willy-nilly, blowing.

The Revelations of Devout and Learn'd
Who rose before us, and as prophets burn'd,
Are all but stories, which, awoke from sleep
They told their comrades, and to sleep return'd.

Up from earth's center through the seventh gate
I rose, and on the throne of Saturn sate,
And many a knot unravel'd by the road
But not the Master knot of human fate.

There was the door to which I found no key
There was the veil through which I might not see,
Some little talk awhile of me and thee
There was—and then no more of thee and me.

Strange, is it not? that of the myriads who
Before us pass'd the door of darkness through,
Not one returns to tell us of the road,
Which to discover we must travel too.

Would but the desert of the fountain yield
One glimpse—if dimly, yet indeed, reveal'd,
To which the fainting traveler might spring,
As springs the trampled herbage of the field.

Tis all a checker-board of nights and days
Where destiny with men for pieces plays
Hither and thither moves, and mates, and slays,
And one by one back in the closet lays.

The moving finger writes, and, having writ,
Moves on, nor all thy piety nor wit
Shall lure it back to cancel half a line,
Nor all thy tears wash out a word of it.

And that inverted bowl we call the sky,
Whereunder crawling coop't we live and die,
Lift not thy hands to it for help—for it
Rolls impotently on as Thou or I.

So let the dervish flout;
Of my base metal may be filed a key
That shall unlock the door he howls without."

Toward an Understanding of Cosmogony

The physical universe, organized as stars, planetary systems, and nebulae, must have had a beginning in time. It is logical to ask what was the status prior to that beginning. If we allege that God created matter, presumably out of nothingness, we are merely echoing theistic metaphysics—and for a simon-pure scientist that way lies confusion. If ever we are to evolve an hypothesis that satisfactorily accounts for the origin and development of the physical universe, the cosmic drama to be unfolded therein must incorporate no "deus ex machina" motive for resolving one of nature's difficult problems, but by sheer marshaling of facts must bring the creative process to a rational climax. This is not tantamount to saying that the scientist must deny the existence of Deity and the validity of religious experience. It implies only that the scientist, as scientist, whether theist or atheist in principle, must regard it his bounden duty to accept the physical cosmos as he finds it, and by relying on all empiric gains to devise hypotheses that will correlate the facts of nature, willing ever to revise these as new facts are tabulated and approved, or without ceremony to discard them if and when a consensus of scientists so orders. For these reasons the writer feels scrupulously bound to avoid the chasm into which unwary scientists plunge when, having reached an impasse, they betray the cause of science by accepting supernatural intervention. To a genuine scientist that spells mysticism, and he knows that, like oil and water, mysticism and science will not mix.

Our physical universe must have had a beginning in time, and that beginning must have occurred in space. Here at least we have something substantial on

which to "rest" a hypothesis—time and space. Even a rank subjectivist will not deny that our physical universe exists in time and space, else that universe would be Maya-pure illusion.

If we decide to take a step further back and ask what was the status prior to the beginning of organized matter, we can hypothecate nothing except space. Where there are no events to be recorded, time can not be said to exist—at least for a scientist, whose duty is to study the relation of events in space-time. Assuming this priority for space—since we can not conceive matter existing where there is no space—we are compelled to posit a universe of emptiness: no atoms with their electrons whirling about protons, just abstract emptiness. Unless, therefore, space has intrinsic potentialities whereby the abstract may, under certain conditions, be transformed into the concrete, we appear to be at the end of a blind alley—a hypothetical space of conceptually infinite extension, without center or circumference, without matter or motion, ungenerative and eternally infertile. On such foundation a scientist can not build. He must have matter and motion if he would construct a material universe; and if to get this matter and motion he must call on supernatural agency, he ceases to function as scientist and becomes a mystic.

To metaphysician and scientist alike space is about the most mysteriously inexplicable of all natural phenomena, and time, so closely bound up with space, is almost as baffling. Therefore, in lieu of the easy, but unscientific, alternative of calling on Deity for help, has not the cosmogonist the rightful privilege of endowing this inexplicable phenomenon, space, with the power to incubate the cosmic twins, matter and motion? This granted, he can visualize an orderly world, slowly evolving through the ages; natural laws empirically established by the method of trial and error, until the time arrives when because of chemical rightness planetary life begins. If space can not be thus endowed with generative power, the scientist must bow to an impasse—or fall back supinely on the "deus ex machina" as sole means of escape from his dilemma.

The writer assumes that space is one of nature's absolutes, having neither beginning nor ultimate ending, a conceptual infinite—else what lies beyond where space ends?—that has the potentiality of giving birth to matter and its universal concomitant, motion. These are twin concepts: matter without motion would indicate a dead universe, and motion in space with nothing to move, would be an anomaly. The parturition period ended, we find as first approximation a universal space of near-emptiness, a space homogeneous and symmetrical to the extent assumed by the distinguished Dutch astro-physicist, de Sitter, namely, with a density of some three or four protons—the nuclei of hydrogen atoms—to the cubic foot. In such a space gravitation would be almost nil, though potentially manifest. The existence of matter in its incipiency by cosmic necessity implicates the existence of motion; for the two are universal correlates, like light and darkness, love and hate, right and wrong. We may think of them as separate concepts on occasion, but we can not totally dissociate them conceptually; they are reciprocals, and one can not function without the other. Thus we approach the status where we can evaluate the words of Descartes: "Give me matter and motion, and I will build the universe."

The antithesis to a near-empty universe is a near-full universe, that is, a universe composed of a giant atom embodying all the matter at present distributed in space. This atom holds matter unorganized and chemically unstable, hence imminently subject to disintegration or violent explosion. The European scientist who hypothecated such giant atom as the beginning of our present expanding

universe appears to have attributed its existence to supernatural fiat. If such an atom did exist some billions of years in the past, the scientist must reason that it was the accretion of matter subsumed in the near-empty universe. Whether such line of evolution can be empirically established is open to serious doubt. However, of one thing we are quite certain: we do not live in a static universe, as the early Einstein equations indicated; but whether our physical universe conforms to de Sitter's "Oscillating Type," to his "Expanding Type 1," or "Expanding Type 2," remains one of nature's closely guarded secrets. Until we gather ampler data; until we can determine whether the curvature of space has a factor that is zero, negative, or positive, we can not know the kind of universe in which we live.

The near-empty and the near-full universe are polar. To a scientist the latter suggests by analogy the classic myth of Athene springing full orbed from the brain of Zeus: but as nature refuses to concoct myths, the cosmogonist declines to rest his case involving *beginnings* on the assumption of a giant cosmic atom. To do so would open the door to supernatural agency.

In the realm of psychic phenomena the easiest explanation of difficulties is that offered by the spiritualist. Likewise in the realm of cosmogonic phenomena the easiest solution of difficulties is that proffered by the Christian theist. Such solution, however, is repudiated by the tough-minded scientist, who as stubborn realist believes that the physical universe came into existence through the operation of natural laws, hence without benefit of Deity, and eternally will conform to these laws without supernatural intervention. If this rules God out of the universe, he retorts, let the devout theist explain satisfactorily how a God, self-created and self-creative, as theologians allege, came to be endowed with the galaxy of attributes well-known, among them omniscience, omnipresence, and omnipotency. Which hypothesis dourly he asks when carefully considered puts the greater strain on man's credulity?

LABAN LACY RICE.

Ware Neck, Virginia.

General Notes

Dr. Bengt Stromgren, Director of the Copenhagen Observatory, Copenhagen, Denmark, spoke before a physics seminar at the University of California, Los Angeles, in the afternoon of March 9, 1950, on "Problems of the Interstellar Medium."

Dr. John G. Phillips, who for some years has been a member of the staff of the Yerkes Observatory, has recently accepted an appointment as assistant professor in the department of astronomy at the University of California at Berkeley beginning July 1, 1950.

Dr. C. Donald Shane, Director of the Lick Observatory of the University of California on Mount Hamilton, gave an illustrated lecture at the University of California, Los Angeles, in the evening of April 3, 1950, on "The 120-inch Telescope and Astronomy in the University."

The new Toledo Astronomical Club was organized at a meeting recently held in the University of Toledo Observatory. C. E. Shinkle, Temperance, Mich., was elected president and Elmer D. Edenburn, 4124 Commonwealth Ave., Toledo, was elected secretary-treasurer. Members will meet the third Tuesday of each

month in the Observatory. The next meeting will be held on April 18, when Dr. Oscar Lee Dustheimer, Professor of Astronomy at Toledo University, will lecture on "The Planets, Children of the Sun."

The Peruvian Astronomical Association

Word has been received from Mr. Victor A. Estremadoyro of Lima, Peru, of the activity of the Peruvian Astronomical Association. The members are constantly improving their equipment by making new telescopes. The Association also issues a bulletin from time to time. It reports the meetings that are held and also records the results of observations in various fields. The current issue consists of pages 17 to 25, inclusive, of Volume II, and is dated for January, 1950.

The Cleveland Astronomical Society

Some 100 members and guests of the society heard Dr. Daniel Harris III of the Warner and Swasey Observatory of the Case Institute of Technology speak on the topic "The Satellites of the Solar System," on March 10, in the Warner Auditorium of that observatory. His fresh and unusual presentation of the historical background and of current problems was thoroughly enjoyed by those present, and will probably appear in full elsewhere in these pages later.

PAUL ANNEAR, *Secretary*

List of New Variables

Astronomische Abhandlungen, issued as Volume 12, No. 1, of the supplement to the *Astronomische Nachrichten*, consists of a list of 1440 new variable stars with comments concerning the nature of the variation, by Dr. Cuno Hoffmeister. The author calls attention to the fact that variable stars are among the most interesting objects in the sky and also that they contribute much to the investigations regarding stellar distances. With this list the number of variables discovered at Sonneberg has mounted to more than 5000. The pamphlet may be obtained from Akademie-Verlag GMBH, Berlin, NW7.

Provisional Sunspot Numbers for March, 1950*

1	88	11	156	21	80
2	62	12	128	22	70
3	83	13	124	23	76
4	128	14	133	24	72
5	134	15	130	25	73
6	148	16	110	26	80
7	184	17	100	27	73
8	187	18	108	28	69
9	163	19	101	29	97
10	150	20	90	30	100
				31	78

Mean Value for March
R = 108.9

*From the Zürich Observatory, furnished by Mr. Neal J. Heines.

English Abstracts of Russian Publications

English abstracts of Russian books and articles in astronomy and astrophysics are made available through the medium of the *Astronomical Newsletter*,

which is issued at irregular intervals from the Harvard College Observatory, Cambridge, Mass. The *Newsletter* was started during the war by Professor Bart J. Bok of the Harvard Observatory, under the auspices of the American Astronomical Society. The wartime series of 36 Newsletters was devoted primarily to those articles which, because of the wartime conditions, were not widely distributed. After the Russian publications adopted the practice of printing only in the Russian language, the American Astronomical Society requested Dr. Bok to renew the *Newsletter* and use it entirely to cover as much of the Russian literature as could be found in this country.

Miss Margaret Olmsted of the Harvard Observatory has undertaken the responsibility for issuing the *Newsletters* prepared by the committee for the distribution of astronomical literature. Those who now participate in the work of abstracting include Dr. A. N. Vyssotsky, Dr. S. Gaposchkin, Dr. Z. Kopal, Dr. L. Jacchia, and Dr. O. Struve who also acts as the coordinator and editor of the group. To date 12 issues have appeared averaging approximately 10 pages per issue. The subscription price is $3.00 for about 50 pages which should be sent to Miss Olmsted, Harvard College Observatory, Cambridge, Massachusetts.

Three-hundred-fiftieth Anniversary of the Death of Giordano Bruno

On February 17, 1600, the Inquisition burned alive on the Campo di Fiora in Rome Giordano Bruno who together with Rene Descartes and Francis Bacon is considered now a founder of modern philosophy. There was no differentiation between science and philosophy at that time and thus many ideas of Bruno in spite of their speculative character opened new vistas to be physical and astronomical thought. Bruno and Leonardo da Vinci were the first to discard the Aristotelian celestial spheres one of which, *i.e.*, the sphere of the fixed stars, was still retained by Copernicus. One of Bruno's arguments was empirical: he pointed out that the existence of the material celestial vault would interfere with the motions of the comets which Tycho Brahe then investigated. The notion of the limitless Newtonian space was thus created. To the question of his opponents why the "fixed stars" appear to us motionless, he answered that their apparent immobility is due to their enormous distances; in the same way "the distant ships on the horizon appear to be at rest, although we know that they are moving." All celestial bodies, including our sun and the "fixed stars" are in perpetual relative motion; there is no absolutely motionless body in the universe, no absolute "system of reference" as we would say today with Einstein. Not only the relativity of space and motion, but even the relativity of time was distinctly affirmed by Bruno. He saw correctly that "absolute time" has a definite meaning only as long as there are absolutely uniform movements by which it could be measured. Because there is no evidence of such regular motion, it is senseless to speak about absolute time. It is obvious that not only the ideas of classical astronomy, but also even the most recent notions of modern cosmology were anticipated by Bruno.

In his conflict with the medieval totalitarian ecclesiastical machinery Giordano Bruno remained completely isolated; so much more we admire today his intellectual honesty which led him to reject any compromise with the external authority. His courage with which he met his physical death will remain a shining example of a mind unbroken by the authoritarian pressure which today on large areas of our planet, in Russia as well as in Spain, stifles freedom of thought with even greater efficiency than in the sixteenth century.

M. Capek.

Carleton College.

The Cleveland Astronomical Society

On April 7, in the Warner Auditorium of the Warner and Swasey Observatory, the Society again had the pleasure of hearing Mr. Leslie C. Peltier, the renowned observer of Delphos, Ohio, speak on the topic "The Amateur Astronomer." In presenting the speaker Dr. J. J. Nassau, the Society's president, mentioned the fact that Mr. Peltier had observed thousands of variable stars, had received ten comet medals, and had discovered five novae. As contributing factors to Mr. Peltier's success, Dr. Nassau mentioned concentration on one field (observing), unusual eyesight (seventh magnitude with the unaided eye), highly developed memory, and good judgment in apportioning his observing time.

The speaker brought out the fact that after thirty-two years of variable-star observing, he still finds that the most interesting field, and probably the most rewarding one for amateurs. The stars U Geminorum, SS Cygni, Z Camelopardalis, and R Corona Borealis were particularly recommended. The four novae which he has discovered (Nova Aquilae 1918, Nova Cygni 1920, Nova Herculis 1934, and Nova Lacertae 1936) were discussed briefly. An interesting point in connection with the first and last of these is that they were both discovered shortly after total solar eclipses. The advisability of keeping continuous watch on the novae was stressed, and the speaker claimed that he has never felt quite as friendly toward the star T Corona Borealis since he barely missed its 1946 flare-up after monitoring it for some twenty years.

In connection with comets, it was mentioned that about one-half of them have been discovered by professional astronomers, despite the fact that there is a tendency among this group to discount such work. It was suggested that perhaps the astronomers take the telescopes with them on their vacations in order to achieve this record. The importance of searching very close to the sun was emphasized.

Some interesting comments concerning his observing equipment followed. Circles are not employed, and a field of about one and one-half degrees is used with a magnifying power of about twenty. The "observatory" is some six feet square and four feet high, and the entire structure is movable in azimuth. Usually one minute is spent in observing a variable and then one-half minute in locating the next object.

A spirited question period indicated the interest aroused by this truly remarkable observer in the audience of over one hundred members and guests.

PAUL ANNEAR, *Recording Secretary*

Burrell Memorial Observatory, Baldwin-Wallace College, Berea, Ohio.
April 8, 1950.

Book Reviews

Anuario del Observatorio Astronomico de Madrid para 1950,—A small-sized volume of 382 pages bearing the above title has recently been received. As the title indicates, it is the Spanish equivalent of the *American Ephemeris and Nautical Almanac*. This volume contains some items not included in the *American Ephermis* and *vice versa*, since they are intended for use by peoples for which some items have different interest. However, the standard astronomical data which are independent of nationalistic habits and customs are the same in both. A large variety of astronomical topics is included. In fact a complete perusal of it would constitute a fairly complete course in astronomy. C.H.G.

Astronomischer Jahresbericht, Vol. 47, issued from the Rechen-Institute at Heidelberg. (Walter de Gruyter and Co., Berlin.)

The volume bearing the above title and listing the literature of the year 1947 has recently been received. It continues the long series of similar volumes and will take its place along with them as a compendium of references, very useful to the student and investigator. C.H.G.

Some Early Tools of American Science, an account of the early scientific instruments and mineralogical and biological collections in Harvard University. xxi + 201 pages, 32 full-page plates, by I. Bernard Cohen. (Harvard University Press, Cambridge, 1950. $4.00.)

The history of astronomy can only have full meaning to those who are familiar with the instruments in use in each period of the past. Standard histories such as Arthur Berry's and the even better known "History of Astronomy in the 19th Century" by Agnes Clerke discuss at length the changes wrought by improvements in telescopes but give the reader not one illustration. Strangely one can search the special treatises on the telescope, Bell's "The Telescope," Dmitroff and Baker's "Telescopes and Accessories," and go as far as the authoritative French "Lunettes et Telescopes" by Danjon and Couder without finding in the historical portions specific details of any but modern instruments.

The deficiency is, for a significant part of the development of American astronomy, happily supplied by the book under consideration. This volume, a notable typographical success, with a foreword by Samuel Eliot Morison, is in effect an elaborately annotated catalogue of the material put on exhibition in Mallinckrodt Laboratory at Harvard in February, 1949. The instruments themselves owe their exquisite restoration to the careful ministrations of David P. Wheatland who was able to put back into working condition such examples of 18th century craftsmanship as the great James Short reflector made for Professor John Winthrop under the supervision of Benjamin in 1768. Though the aperture is under seven inches, this instrument is believed to have been the most powerful in the Western Hemisphere for many years, probably until 1835.

Besides the Harvard telescopes there are described in detail orreries, microscopes, air pumps, electrical apparatus and an all but unique "cometarium." The illustrations bring to the reader an appreciation of the artistry of the workers of former times while the text combines historical detail with anecdotes which give personality to the scientists who used these "early tools" to good advantage. Dr. Cohen has made the understanding of the difficulties and triumphs of the beginnings of American astronomy (and other sciences) easier for both scholar and layman; a contribution for which he is to be thanked.

John W. Streeter.

Vassar College, Poughkeepsie, N. Y.

Peremenniy Svesde (Variable Stars) III, by M. S. Zverev, B. V. Kukarkin, D. J. Martinov, P. P. Parenago, N. F. Florya, and B. P. Zessevich. (Moskva-Leningrad, 147.)

Methods of Investigation of Variable Stars

This volume represents the third and last monograph on variable stars, in Russian, the first two of which were published before the War. This last book consists of two unequal parts: one of one hundred and ninety pages is given to

general methods of investigating variable stars, and the other four hundred and sixty-six pages cover the methods of investigating eclipsing variables.

Kukarkin opens the first part with a short review of the history of variable stars. A considerable portion of the article describes the modern history from the First World War to the Second. The second chapter is written by three authors: Florya, Parenago, and Zverev, who explore the visual, photographic, and general photometric observations, reduction of observation (Parenago), and finally, systematic errors in observations (Zverev).

The third and last chapter of the first part is written by Kukarkin, who considers construction of light curves, determination of epochs and periods; and by Florya, who limits himself to the treatment of changes of period among the variable stars.

The second part of the book is initiated by Zessevich in an introductory chapter in which a derivation of fundamental quantities in an eclipsing system is included in order that in the following chapters, the various methods for computing these quantities from the observed light curves may be illustrated. The gamut of the explorations runs from total eclipses to partial and annular, and eclipses with limb darkening. From many methods, Zessevich prefers that of Sharbe for an approximate solution, and that of Piotrovsky for more accuracy. Zessevich's method of least squares climaxes the procedure. The second half of the chapter is dedicated to elliptical orbits and ellipsoidal systems. Its author is Martinov.

The book is rounded out with numerous and detailed tables for computing elements of an eclipsing system, all of them computed by Zessevich, and many of them already well known, having been published in the *Bulletins of the Astronomical Institute of the Academy of Science (USSR)* in 1939 and 1940.

The book contains so much material and so many original approaches to problems that a consummate review of its value would be warranted, but since most of the original work refers to method, it is scarcely desirable to write one. Students and specialists will accept those parts of the treatment as most useful and illuminating for which their propensities are innate or have an affinity. The reviewer is, however, perturbed by the excess of the decimals in computed elements, since inherently the elements are less accurate than we thought twenty years ago. But certainly Russian students may luxuriate in this book.

SERGEI GAPOSCHKIN

Harvard College Observatory.

Kleine Raketenkunde, by Hans K. Kaiser. ("Quellen des Wissens," 5), (Stuttgart: Mundus Verlag, 1949 [151 pp., 91 ills.] 9 DM.)

Because of the ever increasing publicity which has been accorded to rockets in recent years, people seem to have acquired the mistaken idea that they are being informed about an invention which, together with several others, characterizes World War II and our present era. Little do they realize that during the past seven centuries men not only visualized rockets in one form or another but, at various times, actually produced and utilized them.

This little volume written for non-specialists in an intelligible language and commendable style offers a concise record of the origin and development of these "missiles" from the early thirteenth century to the complex technological problems of our time. With the aid of a well-arranged plan, numerous photographic reproductions, cross sections, and diagrams, the author, founder of the *Gesellschaft für Weltraumforschung,* introduces the reader to the history of rockets, the principles of rocket technology, and the scientific contributions in this field

in Europe as well as in America, particularly in the twenties and thirties, and recent developments with a view towards future possibilities in the interest of science and mankind rather than warfare. Of specific interest is the information regarding the new inventions, the various types and perfections carried out in Germany during the last war, most of which research is now continued under considerable secrecy in other parts of the world. Separate chapters ("A picture of the future: the flight into the universe" and "Present and future problems in rocket technology") treat of the basic physical principles and the potentialities that are associated with man's old dream to investigate the stratosphere and to advance to the stars. The final sections of the book contain annotated bibliographies of select works, both scientific and popular, in various languages, of German stories and novels dealing with astronautics, provided these works are based on some sound scientific knowledge, and of films entirely devoted to this subject. There follow a glossary (*Kleines Raketen-Lexikon*) with rather detailed explanations of technical terms, an index of names and subjects, and a list citing the various sources for the illustrative material. In general the information is given in accordance with bibliographical principles, with the exception of the publications in English where the dates are missing. For the sake of completeness I shall give them here with a few additions: Phil. E. Cleator, "Rockets Through Space," London, 1936; C. G. Philp, "Stratosphere and Rocket Flight," London, 1935 (a revised and enlarged edition appeared the same year; two years later, Philp published at London: Pitman his "Conquest of the Stratosphere"); Wiley Ley, "Rockets: The Future of Travel Beyond the Stratosphere," New York: Viking Press, 1944; 2nd ed., rev. and enl., as "Rockets and Space Travel: The Future of Flight Beyond the Stratosphere," *ibid.*, 1947. The scientific periodical publication in English mentioned here have varying titles, those issued by the British Interplanetary Society began in 1934 and by the American Rocket Society in 1930. I have discovered only one typographical error (*hydrauisch* for *hydraulisch*, p. 76).

The make-up of the book with its heavy glossy paper, clear types, the excellent reproduction of the illustrations, and the solid binding surpass the expectations of those who are familiar with post-war European publications. This work is in every respect a fitting tribute to the pioneer in rocket science, Professor Hermann Oberth (a native of Transylvania), to whom it is dedicated. I feel certain that an English translation of the "Kleine Raketenkunde" would assure the book a wide reading public.

WILLIAM HAMMER.

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Starscope: An Instrument to teach Star Names and Groups in a direct visual manner. Manufactured by Polaris D & M Company, Linden, Mo. $3.95 postpaid.

The Starscope is a pocket-sized instrument which, according to its maker, is being manufactured under license from the University of Chicago. Its purpose is to introduce a beginner in astronomy to the orientation on the celestial sphere of the brighter stars and the constellations to which they belong.

The instrument consists essentially of a viewing lens and a translucent screen, both mounted in a plastic holder. The holder is made in two pieces which may be taken apart in order to insert a star chart and then easily reassembled for viewing. The screen is illuminated from the rear by a small flashlight bulb powered by a penlight-sized dry cell. The latter is mounted on the outside of

the plastic case between a set of metallic clips. The entire instrument has an overall length of about ten centimeters and a maximum diameter of six centimeters.

The Starscope is furnished with a set of 30 circular star charts, of 5½ centimeters diameter each, which can be inserted in front of the screen one at a time. The charts have black backgrounds with white drawings and lettering upon them so that when they are illuminated from behind the screen and viewed through the eyepiece, a clear image of a portion of the sky can be duplicated. Each chart has the most conspicuous stars in a certain region of the sky marked and named upon it together with an artist's conception of the mythological creatures that are associated with the constellations. The various charts are connected by a keying system so that adjacent areas of the sky are named and the beginner can easily know which chart to insert into his Starscope next. The ecliptic and the monthly positions of the planets for the year 1950 are marked upon the appropriate charts.

The scale of each drawing is such that the image of the chart as viewed with one eye can be made to superimpose itself upon the real sky as viewed with the other eye.

It is unfortunate, however, that the manufacturers have chosen to clutter up the charts with cumbersome mythological drawings which have no bearing upon astronomy (except perhaps historically) and which make it extremely difficult to locate the truly important objects on the charts, namely the stars. Admittedly the Starscope is designed for youthful astronomy enthusiasts who are in the process of learning the principal stellar landmarks in the sky, nevertheless, it is difficult to understand why it is necessary in the world of the twentieth century to continue to introduce imaginary figures of ancient mythology into the sky and thereby render it nearly impossible to disentangle the stars and their positions from the drawings which bear little or no resemblance to the configuration of the constellations. It would be more instructive and certainly clearer if the stars were simply connected by faintly drawn lines in order to emphasize the general outlines of the constellations.

The makers of the Starscope are planning to produce a set of charts which are more seriously designed and presumably will not include the mythological figures. Undoubtedly, this will improve the value of the instrument, and its usefulness to those who are learning the stars and the constellations will be greatly enhanced.

Andrew J. Galambos.

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"Investigation of Structure and Development of Stellar Systems on the Basis of Studies of Variable Stars," (in Russian), by B. V. Kukarkin. (190 pages, 28 illustrations, 26 tables. Moskva-Leningrad, 1947.)

This small monograph consists of four chapters in which the author, a universally known astronomer, develops the idea expressed in the above title.

The book commences with a short description of existing types of variable stars, and with an elucidation of the connection between morphological properties (spectrum, brightness, period, and so forth) of variable stars, and structure of galaxies. Kukarkin considers first the period-luminosity relation for the great sequence. He gives the formulae for these relations, formulae which are approximately the same as derived by him in 1937, which show a definite division (break) in the period-luminosity curve at the period of about ten days—a divi-

Note: On the following page, *instead of* the exponent $-2.44/z/0.5$ *read* $-2.44|z|^{0.5}$.

sion of which some astronomers in the United States are seemingly remaining unconvinced. A very convincing and detailed paragraph is next devoted to the luminosity functions of different variable stars, after which Kukarkin leads the reader to the cream of his work: the morphological properties of variable stars are connected with their location in space. He limits himself, however, only to a presentation of the distribution of the periods of cluster variables in our galaxy and in globular clusters; that of cepheids in our galaxy and small Magellanic clouds; and finally that of long-period variables and novae.

In the third chapter he handles the space distribution of different sub-systems of variable stars. He calls a system of stars a "flat sub-system" if it shows a strong galactic concentration, with galactic rotation, like the sun, and having small velocity dispersion (*i.e.*, classical cepheids). As an opposite extreme, he calls a system of stars a "spherical sub-system" if it has weak galactic concentration, shows poorly galactic rotation and has a large velocity dispersion, (*i.e.*, cluster type). He finds the density distribution for cluster variables is well represented by

$$D(R) = 140 \cdot e^{-0.63R}$$

in the galactic plane, where R is in kiloparsecs counted from the center of the galaxy, and

$$D(z) = 80 \cdot e^{-2.44/z/0.5}$$

where z is in kiloparsecs in the direction along the galactic axis of rotation.

In similar fashion he discusses the classical Cepheids, the long-period variables, novae, and the rest of the intrinsic variables. (He does not include in his study the eclipsing variables at all, although they are obviously the strongest tool in all our morphological, cosmological, and epistemological problems.)

The last chapter is occupied with the structure of our galaxy and possible ways for development of stellar systems and elements of their composition. One of the interesting results is Kukarkin's distance from the sun to the center of our galaxy,

$$R = 7250 \pm 175 \text{ parsecs.}$$

It has been derived from the study of cluster variables (assuming that the center of this sub-system coincides with the center of our galaxy). Kukarkin denotes it as "essentially the first reliable direct determination of the distance to the center of our galaxy."

He finishes the book, the first of its kind, with a rather general, broad and lofty presentation of possible developments and ages of stars and stellar systems.

The basic idea of the entire engagingly written book, or the thesis, as Kukarkin calls it, has a conspicuously deductional character: "To different structural and progressive formations of matter in the universe correspond different types of composing elements,—in particular, different types of variable stars."

This idea he had expressed already in September, 1943. That is, as Kukarkin emphasizes, almost one year before the analogous investigation of Baade, whose work Kukarkin interprets as a beautiful confirmation of his ideas.

It is naturally easier to make a deductive approach in science, but any deductive research must always be preceded by the inductive method. There were some investigations prior to 1943 which reflected the idea of Kukarkin; for example, the reviewer's attempt in 1941 to study the galactic system by means of eclipsing variables. Many of our colleagues have contemplated and are contemplating research on similar lines.

The most difficult part of such an approach (deductive) is, of course, the demonstration. Even Baade's simple division into two populations requires many more details. But the introduction of N populations or sub-systems needs much more work and more material. Thus it happens that, despite the grandiloquence of Kukarkin's book—a book which might become classic—the connection between the variable stars and the other not-variable stars (which are by far more numerous), has been demonstrated chiefly by the limited discussion of well-known relations: cluster variables and the spheroidicity of the galaxy; cepheids and the galactic plane with its interstellar matter; the W Virginis group and high distance from the plane, and the like. And the reason for this is that our study was confined to a rather small part of our galaxy. Only within the last few years have we begun to unravel the puzzle of whether or not our galaxy looks from the outside like an open alligator pear with its heavy and large stone surrounded either by a heavy and thick doughnut, or by a light, thin pretzel.

In conclusion, I think it is pertinent to mention also the following aspects. As Struve has pointed out several times *e.g., P. A.*, **58**, 8, 1950) the recent Russian astronomical literature contains not only astronomical research but also reflections on social ideology, politico-historical philosophy; in other words, "Mirovosrenie," or "Weltanschaung." What Struve has said is true, but it is only a part of the truth. One should add that all these philosophical assertions occupy only a few lines in a foreword—the text is immune from them—and that such "criticism" is directed not only against the American astronomers, but also against Russians (Soviet) within the Soviet land. Every group of astronomers represents one or another philosophy which they tacitly accept, though some of them may be gentlemen, some politicians, some connoisseurs of art and music, and some of whiskey. And philosophical views are found in all astronomical literature, whether you read Homer or Eddington.

But even such naked Russian assertions as Struve quotes can hardly constitute a "danger" to American astronomers. These assertions might be called irrelevant, immaterial, incompetent, superfluous, even silly, impudent, brazen, or heroic, but in no way *dangerous;* they are useless (except possibly to the authors).

I should also mention the fact that recently Russian astronomers have begun to complain loudly and often that their papers are receiving little attention, if any at all, by astronomers abroad. Hence there occurs much heated controversy about priority in some idea or some research. The following thought (or truth) might throw some light upon this problem of reading the foreign languages: the farther one proceeds toward the West, the less interest is shown in other cultures, together with an increase of pugnacity for one's own. Thus, among fifty American-born astronomers, for example, there may be one (if any at all) who can read Russian, but among fifty Russian (or Soviet) astronomers, there will be possibly only one who cannot understand English. The explanation might lie in education, interest, natural tendencies,—but that is beside the point.

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